

# Railway Engineering Maintenance



IMPROVED  
HIPOWER

BEFORE ORDERING  
CONSULT OUR ENGI-  
NEERING AND SALES  
DEPARTMENTS

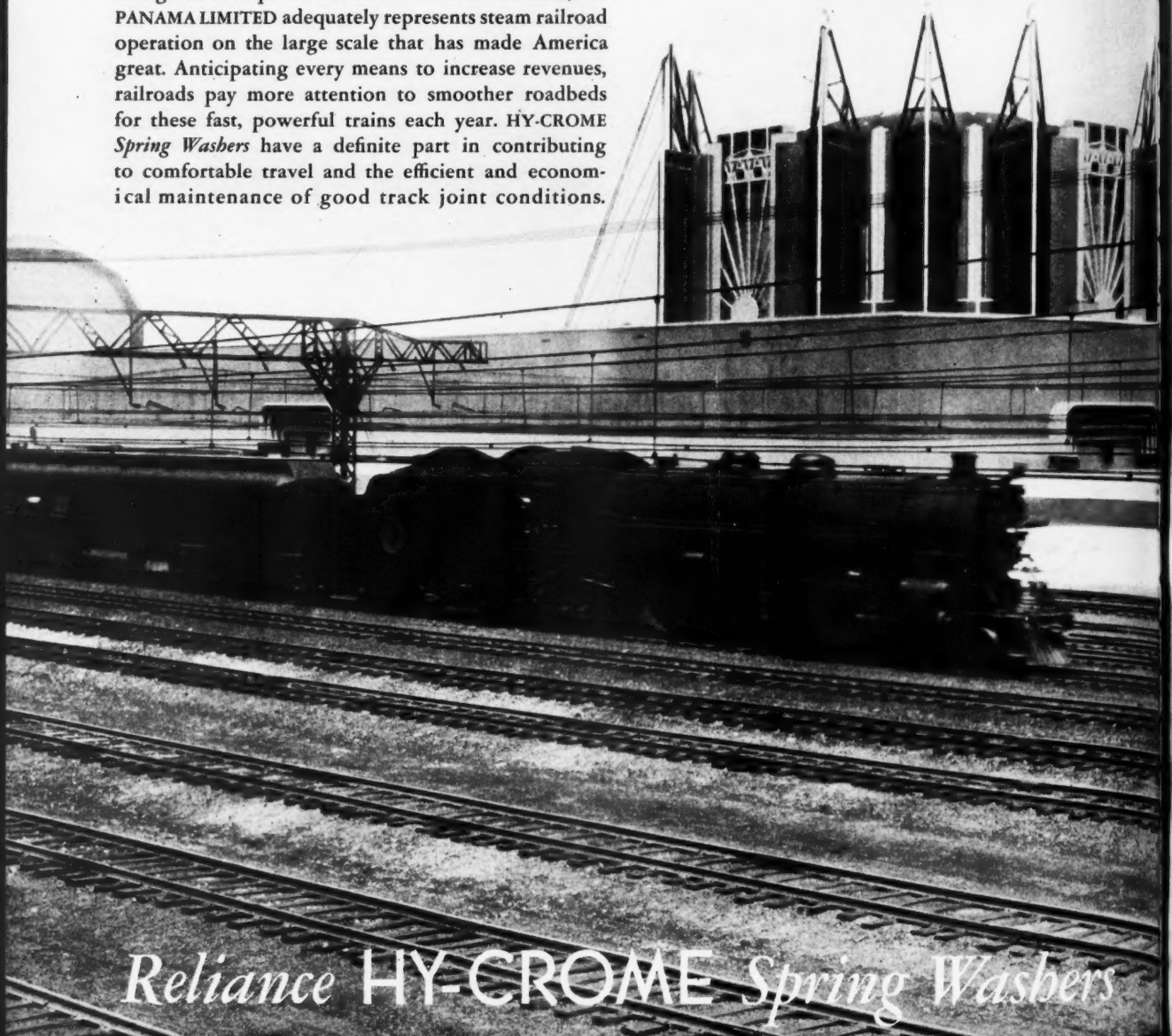
Hipowers greatly  
reduce the rate of  
wear of all joint parts.  
They reduce the fre-  
quency of expensive rail  
renewals and repairs.  
Millions of them in active  
use today are paying for  
themselves over and  
over again. Buy Hipow-  
ers now as you would  
any other money-saver.

# HIPOWERS

NATIONAL LOCK WASHER COMPANY  
NEWARK, NEW JERSEY

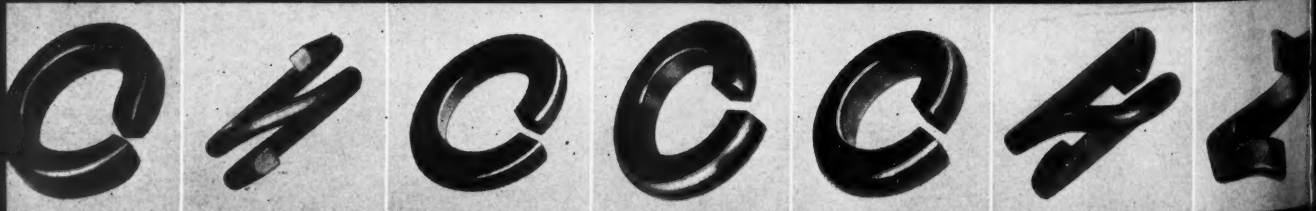
*One of America's Famous Trains*  
**THE PANAMA LIMITED**  
 ILLINOIS CENTRAL SYSTEM

ALL YEAR 'ROUND this famous Illinois Central passenger train, THE PANAMA LIMITED, operates between Chicago and New Orleans on a 20 hour schedule. Here it is moving out of the Chicago yards past the Travel & Transport Building of the Chicago world's fair group, at the start of its 921 mile run south. Completely air-conditioned, luxuriously equipped and given conspicuous care in its maintenance, the PANAMA LIMITED adequately represents steam railroad operation on the large scale that has made America great. Anticipating every means to increase revenues, railroads pay more attention to smoother roadbeds for these fast, powerful trains each year. HY-CROME Spring Washers have a definite part in contributing to comfortable travel and the efficient and economical maintenance of good track joint conditions.



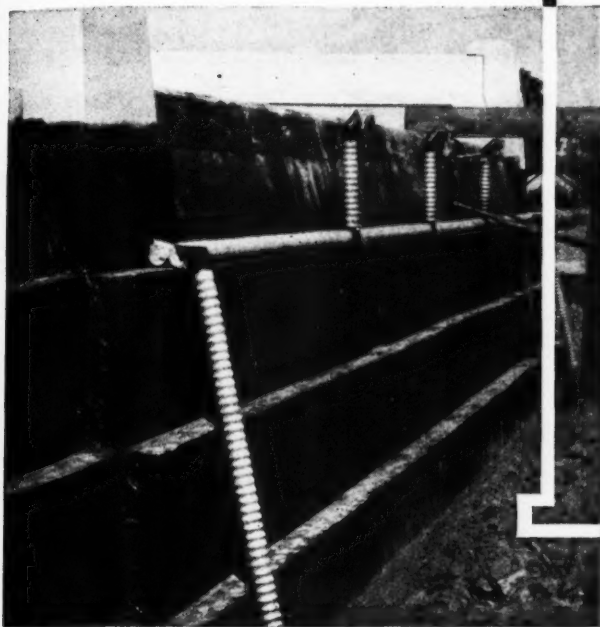
*Reliance* **HY-CROME** *Spring Washers*

REACTIVE Deflected Meets A. R. E. A. Spec.	THACKERAY For screw spike use	HY-REACTION For track bolts	STANDARD For general use	HEAVY DUTY For frogs—crossings	DOUBLE For special use	BONDING Used as rail bolt
---	----------------------------------	--------------------------------	-----------------------------	-----------------------------------	---------------------------	------------------------------



EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON, OHIO  
 Sales Offices: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

# HOW MUCH IS



# 1%

Stabilizing a railway overpass in Birmingham, Mich., with a drainage system of Armco Perforated Pipe

# OF \$60,000 ?

**YOU'RE RIGHT!** It's just \$600.00. And ordinarily, that's all it takes to provide proper drainage for an average grade separation structure. Think of it! Only one per cent of the total cost—to insure your structure against a frequent cause of failure.

You see, when water gets behind a bridge abutment, it adds to the weight of the backfill. Moreover, it softens the material, so that the lateral thrust is increased. In addition, undrained backfilling will freeze and expand—causing

more lateral thrust, besides hastening the disintegration of the abutments.

So, it's important to get rid of the water. And an excellent way to do that is with Armco Perforated Pipe. This efficient subdrain does not clog-up, break, or disjoint. Also, being made of Armco Ingot Iron, you can depend on it to give long, satisfactory service. Remember, too, that experienced Armco engineers are ready to cooperate with you, in adapting this product to your grade separation problems. Just write us.

## INGOT IRON RAILWAY PRODUCTS CO.

Middletown, Ohio • Berkeley, California

(Member of the Armco Culvert Mfrs. Assn.)

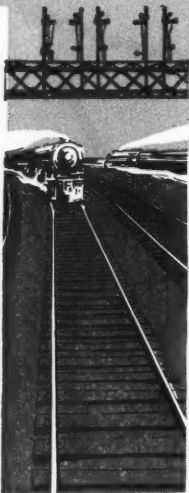
Philadelphia • St. Louis • Salt Lake City • Los Angeles • Minneapolis  
Houston • Portland • Atlanta • Denver • Cleveland • Chicago  
Dallas • El Paso • Spokane



## ARMCO DRAINAGE SYSTEMS

For Grade Separation Structures

# TEAMED UP



**T**HE safety of a railroad is like that of a chain . . . it's as safe as its weakest link. Recognizing this, the railroads, long before "Safety First" became a national slogan, organized for safety.

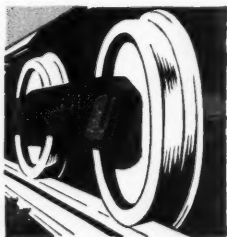
To a considerable extent, that organization meant better, stronger, surer materials. Materials that resist vibration and shock and fatigue. Materials that are designed for specific jobs. Materials that combat the destructive effects of corrosion.

In the development of these materials, steel has played a dominant part. Steel has perfected strong, light wheels . . . many tubular products in which greater reliance can be placed . . . better and more dependable track construction and products. Most recently steel has achieved the new High Tensile products, making it possible to further increase strength and safety without resorting to excessive weight in rolling stock.

In every field of railroading, steel has news for you of better and safer materials. Representatives of these subsidiary companies of the United States Steel Corporation will be glad to discuss them with you.

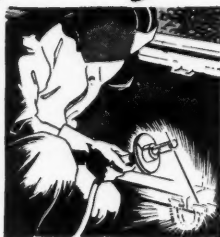
## *There's Safety in these*

Steel structures of all classes, turntables, transmission towers and component parts • Black and galvanized sheets, automobile sheets, electrical sheets, sheets for special purposes, tin and terne plates; Keystone Rust-Resisting Copper-Steel Products; USS Stainless and Heat-Resisting Steel; USS High Tensile Steel • Wire fencing, barbed wire, wire rope, electrical wires and cables, nails,



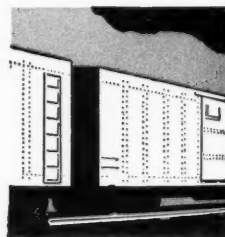
### **WROUGHT STEEL WHEELS**

Carnegie and Illinois wrought steel wheels are safer—more dependable—longer-lived—in service on many of the most modern trains.



### **TIGERWELD RAIL BONDS**

Solid steel terminals—Flash Butt-Welded to the conductor—eliminate burnt or damaged wires. They make for safer signal service.



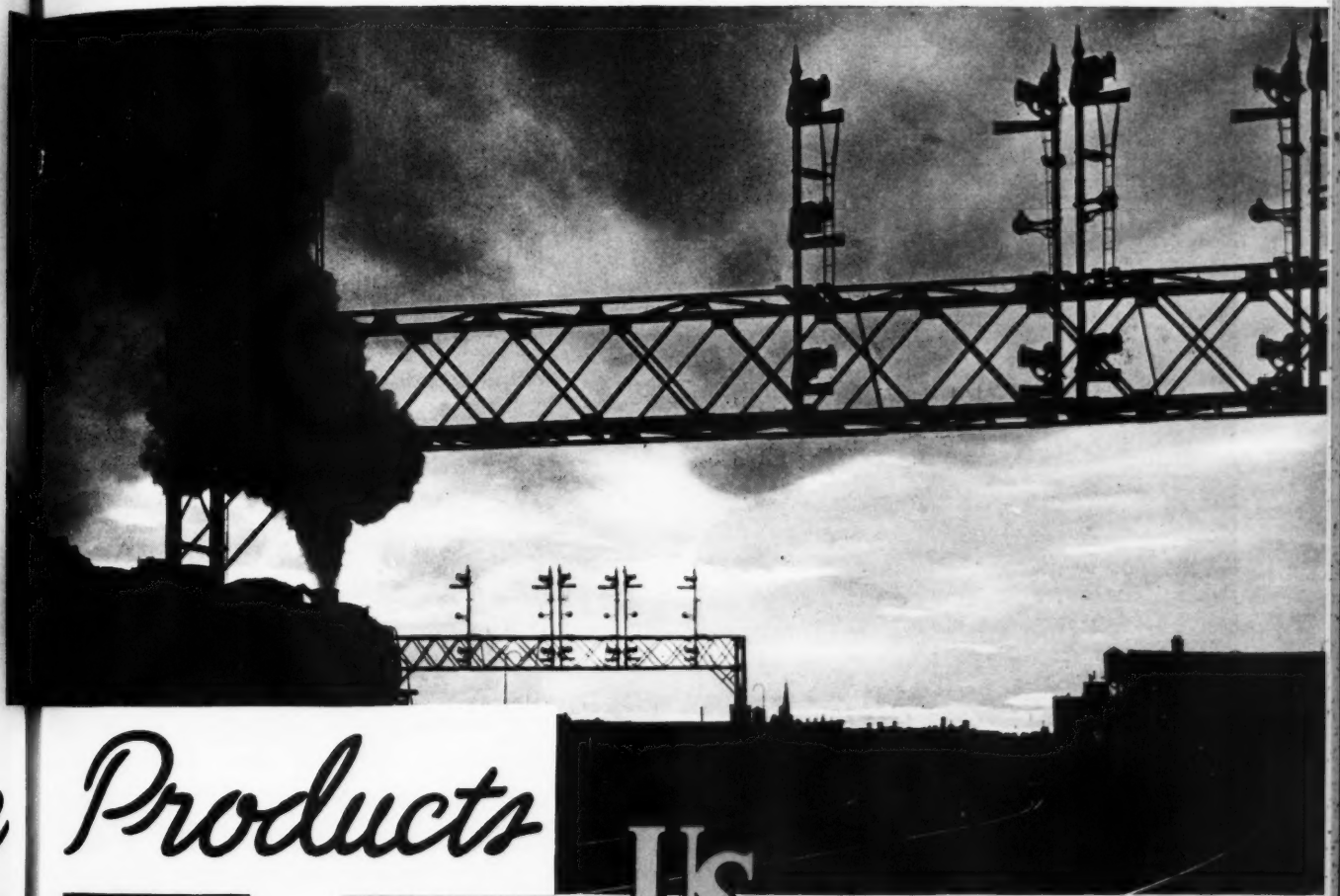
### **USS HIGH TENSILE STEELS**

USS High Tensile Steels in car service effect a weight reduction of 20% of the dead load—with no sacrifice of strength or safety.

manufacturing wires, cold rolled strip steel. Springs • Concrete reinforcement • CB Sections, structural shapes, piling, plates, bars, flats, billets • Axles • Wheels • GEO Track Construction • Rails and track material • Cyclone Chain Link Fence—also lawn fence, wire screen cloth, wire belting, and wire specialties • Special Track Work and Accessories.

*United States*

# FOR SAFETY



## Products



**HEAT-TREATED RAILS BY THE LORAIN SPECIAL PROCESS**

The Lorain process—positive heat-treating control—assures longer life and greater safety for rails, switches and crossings.



**NATIONAL SIGNAL PIPE**

The recognized standard for America's railroads. Made to A.R.A. Specifications.

# US STEEL

AMERICAN BRIDGE COMPANY  
AMERICAN SHEET AND TIN PLATE COMPANY  
AMERICAN STEEL & WIRE COMPANY  
CARNEGIE STEEL COMPANY  
COLUMBIA STEEL COMPANY  
CYCLONE FENCE COMPANY  
ILLINOIS STEEL COMPANY  
THE LORAIN STEEL COMPANY  
NATIONAL TUBE COMPANY  
TENNESSEE COAL, IRON & RAILROAD COMPANY  
UNIVERSAL ATLAS CEMENT COMPANY

Standard pipe, copper-steel pipe, rotary rolled pipe, electric-welded pipe, hammer-welded pipe, boiler tubes, seamless mechanical tubing, special dipped and coated pipe, cement-lined pipe, cylinders, couplings • Universal Atlas Cements.

SCULLY STEEL PRODUCTS COMPANY, *Warehouse Distributors*  
UNITED STATES STEEL PRODUCTS COMPANY, *Export Distributors*

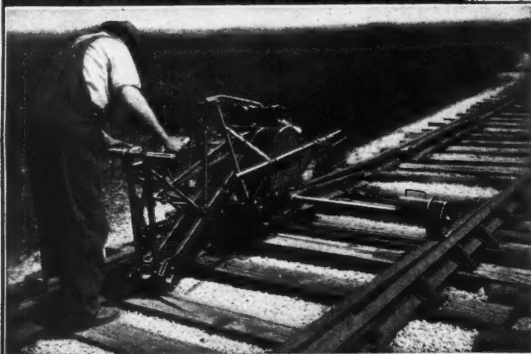
*Steel*  *Corporation Subsidiaries*

# TODAY'S *FASTER TRAINS* DEMAND BETTER TRACK



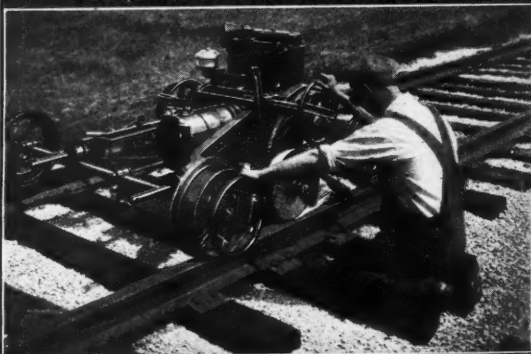
**NORDBERG ADZING MACHINE**

Rail laid on machine-adzed ties improves the quality of track.



**NORDBERG TRACK WRENCH**

Better riding track requires that rail joints be kept uniformly tight.



**NORDBERG RAIL GRINDERS**

They do a smoother and faster job wherever rail grinding is done.

Now that better maintained track and roadbed are required to meet higher train speeds, it is more essential than heretofore that Nordberg maintenance equipment be used for this work. These tools were especially developed to improve the quality of track and do it with less expense. Whether for laying new rail, ballasting or rail maintenance, these tools are a part of the trend toward better track for high speed trains.

## *Here Are Five More Nordberg Tools!*

Power Jack  
Spike Puller  
Utility Grinder  
Rail Drill  
Track Shifter

**NORDBERG MFG. CO.**

NEW YORK CITY  
60 East 42nd St.

LONDON, W.C.2  
Bush House

MILWAUKEE,  
WISCONSIN  
LOS ANGELES, CALIF.  
Subway Terminal Bldg.

# NORDBERG TRACK MACHINERY

# OXWELD PROCESS

*gives longer life to New Rail*

THE hardening of rail ends by the Oxweld Process provides greater wear-resistance at the point of impact and definitely postpones rail end batter.

Since all railroads are carefully watching each item of maintenance expense, a program for the hardening of rail ends should be included in every current budget. The economies from this procedure, though obtained for only a few cents per joint, will be extended over a number of years. These are typical of results regularly obtained on rail-



roads where maintenance is done with Oxweld Railroad Service cooperation.

The majority of Class I railroads are Oxweld clients of long standing. Oxweld Railroad Service assures them of all the advantages of the most recent research and development in the mechanical and metallurgical phases of oxy-acetylene welding and cutting.

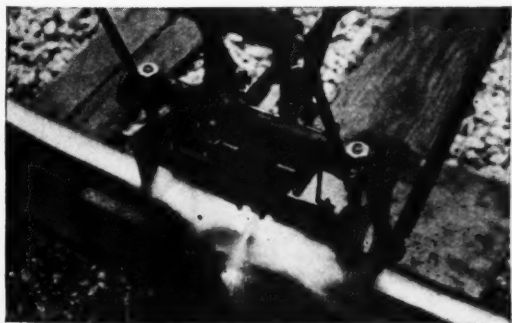
## THE OXWELD RAILROAD SERVICE CO.

Unit of Union Carbide and Carbon Corporation



NEW YORK:  
Carbide and Carbon Bldg.

CHICAGO:  
Carbide and Carbon Bldg.



**MAKING NEW RAIL BETTER**—With the special equipment provided by Oxweld Railroad Service as many as 123 joints have been treated in one hour. This indicates the small unit cost of improving new rail—making it last longer with less joint maintenance.



No. 80 of a series

## Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.  
CHICAGO, ILL.

Subject: Why Advertise?

July 25, 1935

Dear Reader:

I wonder if you have ever thought of the place that advertising occupies in your life and mine today. Not long ago a man prominent in public life was reported to have said that the advertising of breakfast foods, oranges, etc., was an economic waste since it did not increase the consuming ability of a single individual but merely served to displace products more readily available. Granting that this is the effect, is it not a fact that the individual is benefited by the wider selection afforded him and the opportunity presented to eat those foods which he most enjoys?

Advertising has been defined as the art of making one dissatisfied with that which he has. It is a means employed by manufacturers to promote sales. Its appeal lies in the advantages presented for the device or material in question over those now employed. It is through dissatisfaction so created that the railways have made the remarkable progress that they have in the maintenance of their tracks. Back of all such progress have been manufacturers who have produced better and more efficient materials. But this is only half the story—it has been necessary to bring about their use.

It is here that Railway Engineering and Maintenance is rendering a service by providing the medium through which manufacturers bring to your attention the advantages of their products—an action which is being rewarded by your alertness and receptivity to better methods and materials with the result that in many respects maintenance practices on American railways serve as models for the railways of the world. Yes, I am sure that from your own experience, you agree with me that advertising does make the alert man dissatisfied with inefficient and obsolete methods, materials and equipment.

Yours sincerely

*Elmer J. Howson*

Editor

ETH\*JC



## TYTAMPERS

### *Self Contained Units*



- THE BARCO UNIT TYTAMPER needs no heavy or cumbersome equipment to be transported or set on the right-of-way, as each tamper is a complete self-contained unit.
- It can be utilized to the greatest advantage for gang or single-unit tamping.
- Due to its portability, requires only one man to transport it from place to place and operate it.
- Having a low initial cost with a correspondingly low operating upkeep, is ideal for all your tamping jobs.
- These units should be part of the equipment of every gang if track is to be efficiently and economically maintained.

## BARCO MANUFACTURING Co.

1801 Winnemac Avenue, Chicago, Illinois

THE HOLDEN CO., LTD.

In Canada—Montreal—Moncton—Toronto—Winnipeg—Vancouver



## **AIRCOWELDING and AIRCO EQUIPMENT *will help cut track maintenance costs***

Modern streamlined speed demands perfect trackage. It emphasizes the importance of track maintenance and increases the need for building up and heat treating rail ends. It follows that the cost of these operations must be watched more closely than ever.

AIRCOWELDING, the easier, faster building up process, AIRCO-DB Torches, Multi-flame Tips and Two-stage Reduction Regulators—individually and together they assure lower building up and heat treating costs because they embody exclusive time-labor-and-gas-saving features.

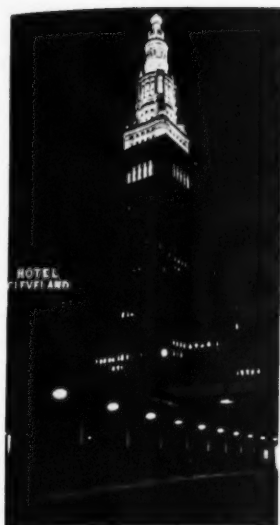
Full details about AIRCOWELDING and AIRCO EQUIPMENT will be supplied on request. And to aid customers in bringing rail maintenance costs down to lowest figures, AIRCO extends the fullest practical cooperation of its RAILROAD DEPARTMENT.

## **AIR REDUCTION SALES Co.**



General Offices: 60 East 42nd St., New York  
DISTRICT OFFICES and DISTRIBUTING STATIONS in PRINCIPAL CITIES

**A NATION-WIDE WELDING and CUTTING SUPPLY SERVICE**



Published on the last Thursday preceding the month of issue by the

# SIMMONS-BOARDMAN PUBLISHING COMPANY

105 West Adams Street, Chicago

NEW YORK  
30 Church Street

CLEVELAND  
Terminal Tower

WASHINGTON, D. C.  
932 National Press Bldg.

SAN FRANCISCO  
55 New Montgomery Street

Samuel O. Dunn, *Chairman of the Board*; Henry Lee, *President*; Lucius B. Sherman, *Vice President*; Cecil R. Mills, *Vice-President*; Roy V. Wright, *Vice-President and Secretary*; Frederick H. Thompson, *Vice-President*; George Slate, *Vice-President*; Elmer T. Howson, *Vice-President*; F. C. Koch, *Vice-President*; John T. DeMott, *Treasurer*.

Subscription price in the United States and Possessions, 1 year, \$2.00, 2 years \$3.00; Canada, including duty, 1 year, \$2.50, 2 years, \$4.00; foreign countries, 1 year, \$3.00, 2 years, \$5.00. Single copies, 35 cents each.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

# Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

August, 1935

<b>Editorials</b> - - - - -	<b>443</b>
Self-Preservation—Treated Wood—Washouts—Conventions—Buckling Track	
<b>Determining Life of Ties</b> - - - - -	<b>446</b>
Interesting facts are revealed in twenty-fifth annual report of the Chicago, Burlington & Quincy on the results of its test sections	
<b>Can Rails Be Laid Tight?</b> - - - - -	<b>449</b>
After a consideration of all the facts involved, C. W. Baldridge contends that the answer is in the negative	
<b>Floods Ravage Railways in New York</b> - - - - -	<b>450</b>
Cause damage amounting to \$1,500,000 on seven roads as approximately 500 miles of track are affected by washouts and slides	
<b>Volume of Timber Treated Increases in 1934</b> - - - - -	<b>452</b>
Statistics compiled by R. K. Helphenstine, Jr., show that amount of wood treated in United States last year was 33.6 greater than in 1933	
<b>What Ballast Discers Can Do</b> - - - - -	<b>453</b>
Report by Committee on Maintenance of Way Work Equipment of A.R.E.A. discusses types of machines available and their applications	
<b>Roofs</b> - - - - -	<b>454</b>
Seventh article in a series, based on the practices of the Northern Pacific, discusses construction of pitch and gravel roofs	
<b>Standardization—Spike Mauls, Chisels and Sledges</b> - - - - -	<b>458</b>
This is the ninth article in a series dealing with the multiplicity of designs in track materials and tools	
<b>Maintaining a Turntable</b> - - - - -	<b>461</b>
Policies that will insure adequate and dependable service from these structures are discussed by H. S. Loeffler	
<b>What's the Answer</b> - - - - -	<b>462</b>
<b>News of the Month</b> - - - - -	<b>469</b>

ELMER T. HOWSON  
*Editor*

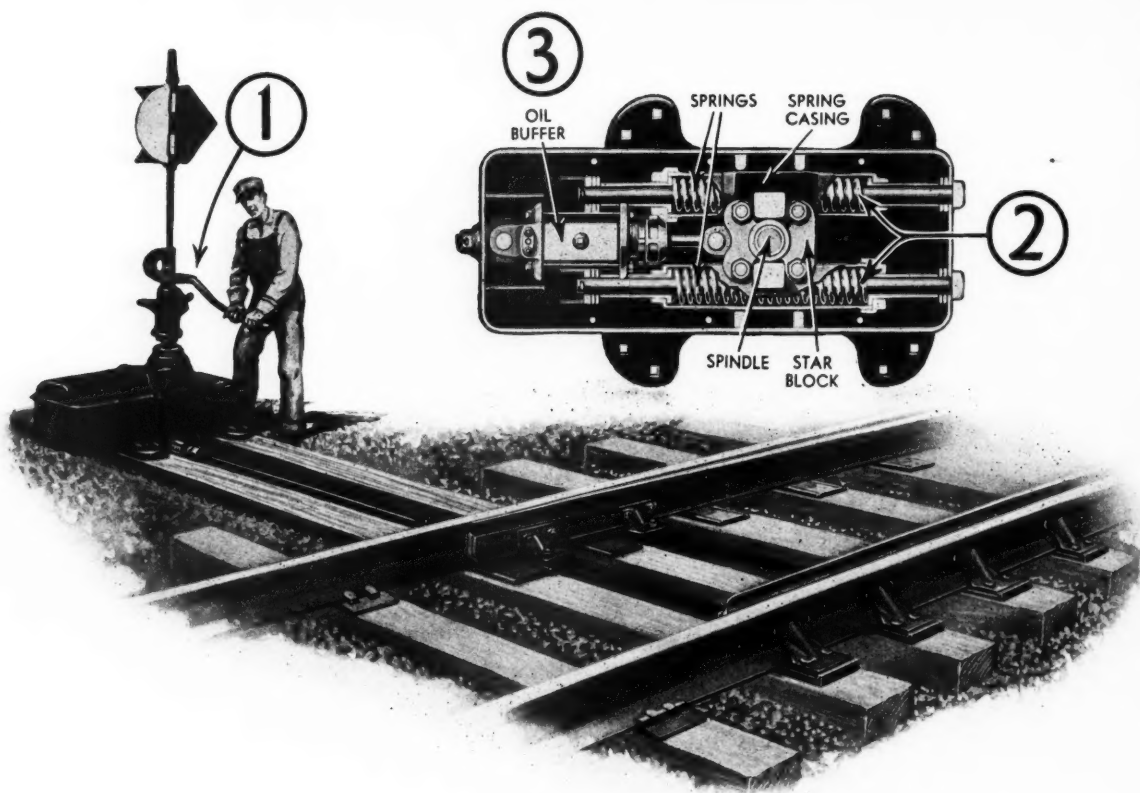
WALTER S. LACHER  
*Managing Editor*

GEORGE E. BOYD  
*Associate Editor*

NEAL D. HOWARD  
*Eastern Editor*

M. H. DICK  
*Associate Editor*

F. C. KOCH  
*Business Manager*



Especially designed for use at ends of double track and passing sidings. The three distinctive features of the Racor 3-in-1 Stand, all combined in one compact housing, are:

- ① A Rigid Hand Throw—the stand cannot be manually closed and locked when an object intervenes between the switch points and the stock rail.
- ② Two Automatic Double Coil Springs, returning switch points after trailing train has passed.
- ③ An Oil Buffer, preventing return of switch points between successive pairs of moving wheels.

## RACOR THREE-IN-ONE SWITCH STAND

Design 100-A

**ECONOMY**—The expense of installation of these stands can be saved in less than 60 days on busy tracks, where switchmen can be dispensed with and train stops avoided as at the ends of double track and passing sidings.

**SAFETY**—The target, being rigidly connected to the switch points, always indicates their actual position. If facing point movements are to be at high speed, standard distant signal protection should be added.

**EXTENT OF USE**—Hundreds of these stands installed at widely distributed points throughout this country are giving very satisfactory service. These stands are also used in a number of foreign countries.



**RAMAPO AJAX CORPORATION • GENERAL OFFICES  
230 PARK AVENUE, NEW YORK**

# Railway Engineering and Maintenance



## Self-Preservation

### The First Law of Life

SELF-PRESERVATION is still the first law of life. Regardless of all other motives, that individual will not long survive who does not give proper consideration to the protection of his own interests. It is a responsibility which he owes to himself and to those dependent on him.

This responsibility is widely recognized, for the average individual is constantly seeking ways in which he can better his lot. Yet in one respect at least the average railway employee, and the average employee of the maintenance of way department as well, is singularly indifferent to his own welfare. This is in promoting the interests of the industry on which he is dependent for his livelihood. All too commonly he considers the prosperity of the railway industry as a whole and of the individual railway for which he works as separate and distinct from his own interests and gives little thought to ways in which he can promote its success.

### Employment and Earnings

Yet nothing is farther from the truth, as has become evident in such a tragic manner during the last five years. In the summer of 1929, before the depression broke, the railways provided employment for 1,750,000 persons, of whom 475,000 were in the maintenance of way department. As earnings dropped off, more than eight hundred thousand railway employees were deprived of employment and thrown on their own resources. Of these, three hundred thousand were maintenance of way employees.

In part, of course, this was brought about by reduced wear and tear on the property resulting from the decline in traffic. In far greater degree, however, it was due to sheer inability of the railways to continue their expenditures, as evidenced by the fact that there is today an accumulated deficiency in maintenance of way exceeding a full year's normal expenditures and the further fact that in spite of this drastic retrenchment, more than 65,000 miles of railway lines in the United States are today bankrupt, a greater mileage than in any previous period in history.

The railways are in dire straits because of the drastic decline in their business during the last five years. This decline is due in large measure to the decrease in activity in all channels of business. To the extent that this

decrease in activity prevails, one can only await the recovery of business in general.

But there is another cause that has affected railway business adversely. This is the diversion of business to other agencies of transportation—especially the highways and to a lesser extent, the waterways and the airways. That this diversion runs into tremendous sums is demonstrated by numerous surveys, the amount being variously estimated as exceeding \$1,000,000,000 annually.

Part of this diversion results from the offering of services which the railways are not prepared to render. Until such time as they can offer equal service, they cannot, in fairness, complain if the patron avails himself of a superior service. But much the larger part of this diversion comes from another condition—the subsidization by the public of these competing agencies to the point where they are able to attract traffic by lower rates.

The unfairness of thus taxing the public at large, in order that those who are in position to use this transportation may receive it at less than the full cost, is as unfair to the taxpayer at large as it is to the railways who are obliged to assume the entire cost of their operations. The unfairness and the economic unsoundness of this policy have been emphasized repeatedly in these columns and many maintenance of way employees have disseminated these messages widely, contributing very directly to an aroused public opinion that is today demanding more and more positively that these newer agencies of transportation be made to pay their full way. All this is beneficial to the railways and will, in the end, bring back to them much of the traffic that has been diverted through these inequitable practices.

### Purchasing Power

But railway employees have still another and even more direct means at their disposal. In spite of the reductions that have been made in their numbers, they still aggregate approximately 1,000,000 persons. These persons received \$1,500,000,000 in wages last year. These wages went into all of the consuming industries—for foods, for clothing, for fuel, for automobiles, for all of the things that people buy.

With those dependent on them, these employees constitute a community of more than 4,000,000 persons. With the employees of those industries which supply the materials which the railways require and with the tradesmen who subsist directly from the purchases of

employees of the railways and railway supply companies, there is a community of at least 10,000,000 persons whose purchasing power, at even today's reduced scale of operations, is dependent on the earnings of the railways. This is a purchasing volume of very sizable proportions. Furthermore, it is distributed into every community in the country, a widespread influence.

It is in the use of this influence that railway employees have been most remiss. How frequently does a railway employee inquire by what means of transportation the merchant has secured the product which he is about to purchase? How frequently does he remind a merchant that the money which he is paying for a purchase came from a railway? In short, is he impressing the merchant with the fact that he, a customer, is interested in the merchant's use of rail transportation and that the merchant can gain the good-will of other railway men by patronizing the agency which makes it possible for them, in turn, to patronize him?

This may seem like a simple measure and one that will exert little influence. There are innumerable instances on record, however, where such interest on the part of some employee has brought very tangible results. It is a means which is within the reach of every employee. If every one of the million employees still on railway payrolls will bring this influence to bear, the results will be surprising.

It is to the selfish individual interest of every employee that railway earnings be increased. That the effect is immediate was illustrated last year when an increase in railway gross earnings of 5.7 per cent brought an increase of nearly \$26,000,000 in maintenance of way payrolls.

The railway problem is a simple one. There is work to be done on the railways. There is a keen desire on the part of railway managements that it be done. The one requirement is increased earnings. These come with traffic. Every unit of traffic which an employee can recover or assist in recovering from some other agency of transportation constitutes a very definite contribution to this important objective.

## Treated Wood

### Railroads Still the Largest User

THE appearance of the annual statistics on wood preservation, which are abstracted on page 452 of this issue focuses attention once more on the dominant position that the railways hold in the market of the timber-treating industry. However, it is improper to consider the railways in this connection merely in the status of a customer, for they are, in fact, a part of the industry itself since not a few roads operate their own plants. But further than that—it is only fair to say that the important position that the industry occupies today is due in large part to the pioneer work done by the roads in fostering timber preservation and in expending large sums for treated wood at a time when the economy of such investments had not been thoroughly established by long time service records.

Since the railroads were the first large customers of the industry, it is not surprising that the relative proportion of the total volume of wood treated each year consumed by the railroads should decrease measurably as other industries and the public at large gained some knowledge of the merits of treated wood. Thus, the volume of wood in treated crossties, which represented 81.7 per cent of all wood treated in 1909, amounted to but 50.7 per cent in 1934. There has, thus, been a marked increase in the treatment of wood for other uses, but the fact remains that crossties alone still represent more than half the total.

Including switch ties, the amount of wood treated for use in railway tracks in 1934 represented 54.7 per cent of the total. But this does not tell the whole story, for included in the total under headings of Piles, Poles and Construction Timbers are large quantities of wood treated for railroad use. It is obvious, therefore, that the railways, who fostered the development of timber preservation, are still the chief beneficiaries of the advances that have been made in the various processes for increasing the service life of wood.

## Washouts

### What Can Be Done About Them?

EXTENSIVE flood damage to railway property throughout a large part of the United States during the present season, focuses attention on one of the most perplexing of all problems—the degree of security that should be provided in an engineering structure against inundation, injury or complete destruction during periods of extraordinary runoff. The answer calls for the exercise of a high order of judgment, whether founded on ordinary common sense or an involved economic study.

That it is not economically feasible to protect tracks, bridges and buildings against the ravages of the maximum possible flood, even if the magnitude of the runoff or the stage of water can be estimated, has been clearly shown by the experience of the recent period of extraordinary high waters. The accrued interest on the extra cost incurred in building a railroad to insure its safety against a flood that would not take place for 50 years would, in most cases, amount to a sum many times greater than any possible losses due to property damage, suspension of traffic or other consequences ordinarily experienced when the unusual flood eventually takes place.

However, all suspensions of traffic because of water troubles are not the result of cloudbursts of unusual intensity or floods of unprecedented volume. Maintenance officers of long experience on a given section of line have not infrequently had to deal more than once with washouts in exactly the same location, and there are places where they must be on the lookout for trouble after every heavy rain. In some of these cases, investigations have shown that the cost of corrective measures is so great that the improvement cannot be justified, but there are many others in which a reasonable expenditure would prevent a recurrence of the periodic trouble.

But damage to tracks and structures by heavy stream discharges has not been confined to locations where the

original bridge opening was not large enough or the track was constructed at too low an elevation. Not a few structures have failed because of changes in the physical surroundings following their construction. In two bridge failures occurring within the last four years, changes in stream flow that followed the construction of highway bridges upstream from the railway bridges were the primary causes of the undermining of the railway structures. A more common phenomenon is the progressive filling up of the stream beds under bridges on lines along the foot of bluffs or hillsides.

But whatever the cause, it is of little moment at the time that the trouble occurs. The only thing that counts then is the effort made to repair the damage. However, after traffic is restored steps should be taken to investigate the cause of the washout, overflow or scour, and determine whether any means can be devised to prevent its recurrence. Of equal importance is the study of conditions at other locations where comparable conditions might lead to similar trouble. And with the experience of past weeks fresh in mind railway managements should be especially receptive to suggestions for greater security of tracks and structures against the ravages of floods or heavy stream discharges at vulnerable locations.

## Conventions

### Make Your Plans to Attend, Now

IF there were any doubts in the minds of the railway executives as to the wisdom of their action in consenting to the resumption of convention activities on the part of the Roadmasters' and the Bridge and Building associations last fall, such doubts were definitely allayed by the excellent programs, business-like procedure and sustained interest that characterized the meetings of those two organizations. Beset with the obstacles that followed as a natural result of the suspension of major activities for nearly four years, the officers of the associations were confronted with a real task in their efforts to kindle a renewed enthusiasm in a sufficient number of members to insure a worth-while attendance, but everyone who attended was amply repaid for any sacrifice he made in order to be present, for the programs were a source of inspiration as well as valuable and exceedingly practical information.

Fortified with the success of those two meetings, the executive committees of the associations laid plans at once for still better conventions in 1935, and in this endeavor the circumstances now confronting them are far more propitious. The critical task of restoring the associations to full activity was completed a year ago, and relieved of any uncertainty as to the holding of conventions, the committees have undertaken the preparation of their reports with old time enthusiasm; some have their work substantially complete.

The Roadmasters' convention on September 17-19 will be of more than usual interest because it will be the fiftieth meeting of that body since its organization in 1883, and plans have been laid for some appropriate recognition of this significant fact at one of the sessions. Except for this special feature, however, the program will

be devoted to a discussion of up-to-the-minute problems of the supervisory officer.

Every railway officer whose duties give him a direct interest in the work of either of these associations should make an effort to attend the conventions this year. It is not too early to lay his plans for this now.

## Buckling Track

### Simple Precautions Will Prevent

DURING midsummer, and particularly during August, buckling track occurs more frequently than at other seasons. The reason is not far to seek. The days are hotter, there are more sunny days and the temperature generally remains relatively high at night. The result is that the rail absorbs more heat and rises to a higher temperature than at other times. Furthermore, at this time the maintenance forces are usually engaged in surfacing, which requires the loosening of the ballast in the cribs and the lifting of the track from its bed.

If the temperature in the rail is greater than the expansion allowance has provided for, the rail will be "tight" and will develop longitudinal stresses in compression corresponding to the deficiency in expansion allowance. In this condition it is unwise to disturb the track, either by loosening the ballast in the cribs or on the shoulders, or by lifting with jacks, for the rail will attempt to relieve itself by moving sidewise enough to compensate for the extra length.

If the rail is tight, it should not be disturbed until measures have been taken to prevent buckling. If some of the joints are frozen and the expansion has not been taken up, the bolts should be loosened slightly and the bars tapped lightly with a hammer. If this is not sufficient to correct the trouble, short rails should be set in at proper intervals to obtain the needed expansion. It is a wise precaution at this season for a surfacing gang to keep on hand a pair of rails several inches shorter than those in the track.

Other means of relieving the condition should be exhausted before resorting to the use of short rails, however, for this will eventually result in excessive openings between the rail ends at some other point when cooler weather comes. Sometimes, in emergencies, the difficulty can be overcome temporarily by using switch points and requiring trains to reduce speed, although this practice has little to recommend it, except in cases where the track has already buckled and it is necessary to avoid considerable delay to trains.

If the rails are not very tight, it is possible to do surfacing without causing the track to buckle, provided certain precautions are observed. Both rails should be raised together and tamped at the same time. The jacks should be exactly opposite and extra care should be exercised to insure that neither one is leaning. The ballast should be disturbed as little as practicable, both during the raise and while tamping. Both ends of the ties should be tamped simultaneously, and the ballast returned to the cribs and shoulder immediately after the tamping is completed. If necessary to renew ties during the operation, two adjacent ties should not be removed at one time.

# Finding Out How Long Ties W

A QUARTER of a century is a long time to continue an individual experiment. Yet this is what the Chicago, Burlington & Quincy has done in carrying out a test on 25,000 ties to determine the relative merits and life of 20 different tie timbers. This test, which will be continued until the last tie is removed, involves 25 widely separated locations, in each of which approximately 1,000 treated and untreated ties were placed in 1909 and 1910, since which time they have been under constant observation.\* Since this original experiment was undertaken, other tests have been added which at present include about 220 separate completed and uncompleted installations involving treated and untreated timber for a wide variety of purposes.

As an indication of the fund of valuable information that is being obtained as a result of this test, the twenty-fifth annual report, dated January 1, 1935, reveals that 4,642, or 22 per cent of the treated ties still remain in the track, while only 3 of the untreated ones are still in service.

\*Previous references to these installations will be found in *Railway Engineering and Maintenance* for February, 1934, p. 61; August, 1929, p. 301; and July, 1932, p. 440.

In other words, the actual average life of the treated ties to date is 18 years, while their ultimate average life is estimated to be 20 years. In contrast, the average life of the untreated ties was only 5.6 years, including a considerable number of white oak ties, the average life of which was 11 years.

## Comparative Life

There is also a wealth of other interesting and valuable information in the report, particularly that pertaining to a number of woods that are not commonly considered to be suitable for crossties. For instance, while untreated cottonwood had an average life of only 2.9 years, creosoted ties of this wood have shown an actual average life of 23 years to date, and 65 per cent of the original number still remain in service. Still more striking, only seven of these ties have failed from decay, although this was the reason for the removal of practically all of the untreated ones. Even including a number of damaged ties, it is expected that the ultimate average life of the test ties of this species will be 29 years.

Equally striking, untreated sycamore

more lasted only 3.3 years; yet after 25 years, 60 per cent of the creosoted ties of this species are still in the track. They have an actual average life to date of 22 years and an expected life of 27 years. Similarly, creosoted tupelo gum ties which, when untreated, had a life of only 3.5 years, are expected to show an average life of 24 years, the present average being 21 years, with 41 per cent of the original ties still in service.

During the 25 years that the test has been in progress, the causes for removal include decay, splitting, broken by derailments, shake, check, burning, rail cutting and a few for which no reason was assigned. Ninety per cent of the untreated ties have been removed because of decay, as contrasted with 30 per cent of the treated ties. By processes of treatment, the percentage of decayed ties has been, Burnett, 50 per cent; Card, 30 per cent; and straight creosote only 15 per cent.

Among the major causes for removal, other than decay, were splitting and rail cutting, both of which account for a large number of the failures in the treated ties, but practically none in those that were not



One of the Test Sections On Lines East. Although the Original Ties Are Now 25 Years Old, they Cannot Always Be Distinguished from Those Applied Later to Replace Failed Ties

# es Will Last

In 1909 and 1910, the Burlington installed 25 test sections of ties to determine, first, the relative life of treated and untreated timber; second, the relative life, treated and untreated, of 20 different species of wood available to it for tie purposes; third, the relative life of these timbers when treated by different processes; and, fourth, the effect of climate and traffic density on the life of the ties. A complete life history has been kept of every tie since the date of insertion and a detailed inspection of every test section has been made annually, this article being an abstract of the twenty-fifth report.

treated. In this connection, it should be kept in mind that when these installations were made, anti-splitting devices had not yet come into use. For this reason, splitting has caused a large number of failures, and among the ties treated by the Card process more ties have been removed because of splitting than for decay.

## Tie Plates

Likewise, tie plates were not in general use in 1909-10 and those that were available were small, as compared to present designs. In fact, tie plates were applied in only a few cases at the time of installation, and in the remainder only after several years. As a consequence, rail cutting has accounted for a relatively large number of failures, particularly in the softer woods. Furthermore, none of the ties was adzed or bored prior to treatment, for this practice was not in vogue at that time, for which reason, a certain amount of adzing was necessary during installation.

Again, the rail on some of the test sections has been changed as many as two or three times, adzing being required in each case. Probably rail cutting, rail renewal and the incidental adzing and respiking have started

This Test Section on the La Crosse Division Was Installed in 1910, Yet After 25 Years Many of the Original Ties Are Still Sound and Serviceable



or accelerated the failure of some of the ties which have been listed as having failed by reason of decay. At the time this experiment was undertaken, it was not uncommon to select the largest and best ties for test purposes. In this test, however, this was avoided, the ties being the run of the yard, except as necessary to insure that all of the available varieties of wood would be represented. This is attested by the fact that all sizes from 1 to 5 were included and by the further fact that shake has been one of the major causes of failure.

## Data Summarized

A summary of these and other data relating to the ties in these 25 test sections is given in the two tables that are shown on the following page. The upper tabulation shows the number of ties, classified by treatments, that were inserted on both eastern and western lines, the Missouri river being the dividing point. Other data include the percentage removed for decay, for other causes and for all causes; the actual average life to date and the estimated average life, separately for eastern and western lines;

and a summary for the system. In both tables, when more than 90 per cent of the ties in any classification have been removed, the actual average life to date and the estimated average life are assumed to be the same.

In the other table this information is repeated in part for Lines East, the classification being by species as well as by treatments. It will be noted that the actual average life to date and the estimated life for each species and treatment are shown. While the data with respect to individual species vary somewhat from the corresponding data for the Lines West, on the whole they are typical of the results obtained for the system. As an example of these variations, owing to the drier climate and longer winters west of the Missouri river, the untreated ties had a slightly longer average life on the Lines West than on the Lines East, but the drier climate has caused more of the treated ties to fail from splitting.

At the time these test ties were installed, the Card process was employed for treating all ties except Douglas fir, western yellow pine and lodgepole pine for use on the Lines

West. These woods were treated with zinc chloride, using  $\frac{1}{2}$  lb. of dry salt to the cubic foot. The Burnett process was discontinued early in 1930 and the Card process was used exclusively until 1933. During 1933, a new standard for treatment was adopted, in which a 50-50 creosote-petroleum mixture is used, with a net retention of 8 lb. per cubic foot.

This company treats ties at its own plants at Galesburg, Ill., and Sheridan, Wyo., and at commercial plants at Denver, Colo., and Metropolis, Ill. During 1930, facilities were installed at Galesburg for pre-adzing and pre-boring the ties treated at that plant. Similar equipment was installed at Sheridan and the adzing and boring of ties at Metropolis was started in the same year, in 1933, at which time incising machines were added at the Sheridan plant, at which considerable Douglas fir and lodgepole pine are treated.

Anti-checking devices are employed regularly, being applied to all hardwood ties, and to others as needed, immediately after they are yarded. Additional applications are made to the softwood ties as indication of checking develops during seasoning. For this purpose, three forms are used, including 5 and 6-in. S-irons, 5 and 6-in. C-irons and 6-in. Beegle, or "Safe-Tie," devices.

For a number of years prior to 1930, the average life of ties on this road, as indicated by the annual renewals over a considerable period, was estimated to be 19 years. It is expected that the new method of treatment, combined with pre-adzing and pre-boring, the incising of the more refractory woods and careful watch to avoid checking, will raise the average life to 23 years.

Since 1932, artificial seasoning of green and semi-seasoned oak ties has

been practiced in an experimental way at Galesburg. The technic of this method has now been developed to the point where enough ties to care for immediate needs are being seasoned in this manner and treated with the creosote-petroleum mixture. The principal advantage claimed for this

wooden structures by termites, which have already been found to be infesting buildings (several at some points) at Galesburg, Ill., Galva, Aurora, Lombardville and St. David; at St. Joseph, Mo., Tina and Linous; at Grafton, Neb., McCook, Sutton, Fairmont, Table Rock, Wy-

#### Summary of Record to Date

Process	Lines East		Percentage of original ties removed			Average life—Years	
	Placed originally	Total out to date	By reason of decay	For other reasons	All causes	Actual to date	Estimated
Straight creosote.....	2,046	1,004	16	33	49	21.9	26
Card .....	10,242	8,150	29	50	79	18.3	20
Burnett .....	1,578	1,487	51	43	94	15.9	15.9
Untreated .....	2,046	2,043	89	10	99	5.4	5.4
Total treated .....	13,866	10,641	30	47	77	18.5	21
Total all ties.....	15,912	12,684	37	42	79	16.9	20

Process	Lines West		Percentage of original ties removed			Average life—Years	
	Placed originally	Total out to date	By reason of decay	For other reasons	All causes	Actual to date	Estimated
Straight creosote.....	1,236	670	15	39	54	20.5	25
Card .....	5,591	4,762	32	53	85	17.5	19
Burnett .....	910	888	48	49	97	14.9	14.9
Untreated .....	1,226	1,226	91	9	100	5.8	5.8
Total treated.....	7,737	6,320	31	51	82	17.7	20
Total all ties.....	8,963	7,546	39	45	84	16.1	19

Process	All Ties		Percentage of original ties removed			Average life—Years	
	Placed originally	Total out to date	By reason of decay	For other reasons	All causes	Actual to date	Estimated
Straight creosote .....	3,282	1,674	15	36	51	20.5	25
Card .....	15,833	12,912	30	51	81	17.5	19
Burnett .....	2,488	2,375	50	45	95	14.9	14.9
Untreated .....	3,272	3,269	90	9	99	5.8	5.8
Total treated.....	21,603	16,961	30	48	78	17.7	20
Grand total.....	24,875	20,230	38	43	81	16.1	19

method is that it shortens the seasoning period by about six months. While no final conclusions will be drawn until the performance of these ties in the track can be observed for a sufficient time to permit intelligent judgment to be passed, it is the present belief that the most satisfactory method of processing oak ties is to air-season them thoroughly before treatment.

This road has been greatly concerned about the destruction of

more, Alma, Hastings, Danbury, Oxford and Holdredge; at Dakoming, Wyo.; at Washington, Kan.; and at Burlington, Iowa.

It is difficult to tell where these insects are at work, since they are rarely seen and usually work in sound wood. After they have completed their destruction, however, the interior of the wood appears to be decayed, since fungi and other wood-destroying organisms gain a foothold in the residue which they leave.

#### Summary of Results on Lines East—Classified by Species

Species	Untreated			Card Process			Burnett Process			Creosoted			Estimated life—Years		
	Per cent removed for	Other Causes	Aver.† Life Years	Per cent removed for	Other Causes	Aver.* Life Years	Per cent removed for	Other Causes	Aver.* Life Years	Per cent removed for	Other Causes	Aver.* Life Years	Creosote	Card	Burnett
Ash .....	99	1	5.1	17	67	18.4	50	44	18.3	32	63	16.6	16.6	19.0	18.3
Beech .....	98	2	4.6	42	48	17.4	52	43	15.5	7	20	23.4	31.0	18.0	15.5
Birch .....	99	1	3.6	36	45	17.5	48	52	12.9	49	20	22.0	23.0	20.0	12.9
Chestnut .....	28	72	9.4	18	82	10.1	—	—	—	—	—	—	—	10.1	—
Cottonwood .....	95	5	2.6	26	50	18.6	—	—	—	1	34	22.9	29.0	21.0	—
Cypress .....	78	20	8.8	10	68	18.8	none	68	20.9	4	28	23.6	30.0	21.0	23.0
Elm .....	91	9	4.8	24	45	20.1	43	47	18.5	19	26	22.4	27.0	23.0	18.5
Gum-red .....	97	3	3.8	37	42	18.6	66	33	11.6	29	37	19.5	23.0	20.0	11.6
Gum-tupelo .....	98	2	3.0	18	41	20.8	47	51	15.2	21	38	20.7	24.0	24.0	15.2
Hemlock .....	100	none	4.7	27	58	17.8	45	46	17.0	26	49	19.1	21.0	19.0	17.0
Hickory .....	89	11	5.5	30	64	16.2	11	67	21.0	10	40	23.2	26.0	16.2	21.0
Maple-hard .....	98	2	4.3	34	37	19.7	44	46	19.4	37	15	22.7	26.0	22.0	19.4
Maple-soft .....	99	1	3.4	46	39	16.6	64	36	13.4	38	39	18.9	21.0	19.0	13.4
Oak-pin .....	96	4	6.4	19	49	20.7	39	35	21.7	3	27	23.1	30.0	23.0	22.0
Oak-red .....	96	4	5.1	21	55	19.5	52	43	17.1	3	35	22.8	28.0	21.0	17.1
Oak-white .....	88	12	10.8	38	55	17.1	60	40	17.4	4	32	24.4	29.0	17.1	17.4
Pine-loblolly .....	99	1	5.5	27	45	18.6	73	26	12.3	8	41	22.0	26.0	22.0	12.3
Poplar .....	94	6	5.1	41	53	15.3	40	56	14.3	12	36	22.1	26.0	15.3	14.3
Sycamore .....	98	2	2.9	40	26	18.7	70	29	13.7	28	17	22.1	27.0	23.0	13.7
Tamarack .....	96	4	4.9	21	71	17.9	38	54	17.9	10	68	20.7	21.0	17.9	17.9

\*To date

†Actual

While one effective method of preventing termite attack is to use creosoted wood in sills and subfloors, this may be impracticable in buildings already erected. For such structures, several methods of eradication are under consideration.

All bridge timbers are preframed and prebored. During the last year, some improvements have been made in this practice, but the work is still being done with portable power tools. It is stated in the report that more accurate and more economical results can be expected when the stationary boring and framing equipment is installed, which has been authorized.

Heretofore, it has been the practice to purchase surfaced Douglas fir for bridge material. Considerable difficulty has been experienced, owing to the fact that there is some difference in the amount of shrinkage of the different timbers during seasoning. This has necessitated a certain amount of shimming, even on new structures. In addition, surfaced timbers cost more than those in the rough. To overcome these difficulties, a planer has been installed at Sheridan and in the future, all bridge material will be surfaced at this plant immediately before treatment.

In addition to the 25 test sections of ties which have been discussed at length in the report, additional tests to the number of about 220 have been completed or are still under way, covering a wide range of treated material for a variety of purposes. Some have been undertaken to determine the merits of certain species of wood or of certain methods of treatment or of these processes when applied to different species of wood. Others involve the suitability of treated wood for some types of structures or parts of structures. Involved in these tests are bridge timbers, bridge ties, piling, drawbridge protection, bulkheads for slide protection, crossties, switch ties, crossing plank, telegraph and telephone poles, building lumber, flooring, water tanks and tunnel lining.

Based on the data which have been mentioned and other experience in the use of treated wood, the report states that improvements in methods and technic made in recent years will contribute to a longer service life for the forest products which are used on this road, although it will still be several years before the full benefits can be realized from these improved practices. These include, in part, pre-boring and pre-ading of all ties; incising fir ties and timber; the use of the 50-50 creosote-petroleum mixture for treatment in lieu of the Card process; sawing the ends of gum and

southern pine ties for inspection prior to treatment; the more extensive use of anti-checking devices; bolting the ends of badly split oak ties; painting the adzed surfaces of ties with hot creosote; better care in the handling and use of treated material, which are now covered by definite instructions; the use of larger tie plates; improved ballast conditions; and the present practice of treating ties as soon as the timber is ready for treatment, instead of waiting until such time as the ties are needed.

These 25 test installations, together

with all other uncompleted tests are inspected annually by the superintendent of timber preservation in company with the local and district maintenance officers. The test sections of ties were made by the late F. J. Angier. After Mr. Angier severed his connection with the road, the late J. H. Waterman had supervision over them until his retirement as superintendent of timber preservation in 1927. Since that date all experimental installations and inspections have been made by Mr. Waterman's successor, H. R. Duncan.

## Can Rails Be Laid Tight?\*

By C. W. Baldridge

Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

FROM the beginning of the railways, there has been a steady although exceedingly slow trend toward increasing the length of rails, this length having grown from 30 to 39 ft. since the beginning of the century, and at present 45-ft. rails are under discussion. While this trend has been retarded by the length of cars for shipping the rails, another factor has had an important influence in slowing down the movement toward longer rails.

Like other metals, except antimony, steel expands when heated and contracts as it cools. The magnitude of these volumetric changes under varying temperatures is such that in one mill a new 110-lb. rail must be cut off by the hot saws to a length of 39 ft. 8.13 in., in order that it may be 39 ft. long when it cools to 60 deg. F. Careful calculations of the expansion and contraction of steel shows that a 39-ft. rail changes its length slightly more than 1/16 in. for every 20 deg. change of temperature, while the exact change for a mile of rail is 41.18 in. for a change of 100 deg.

When rails are exposed to direct sunshine, they absorb heat and when the temperature of the air on a clear day reaches 100 deg., the temperature of the rail may be as much as 112 to 120 deg., depending on the wind and other factors. This indicates that there are few places in the country where rail does not pass through a

range of as much as 100 deg. during the year, increasing and decreasing its length through expansion and contraction by about 41 in. to the mile.

When the temperature of the air is around 70 deg., it may be expected that the rail on a clear day will not be below 85 deg. For this reason it will have already expanded to the extent that higher air temperatures will not increase the length of the rails enough to do any damage. On the other hand, if the rail is laid tight at a temperature below freezing, when the temperature reaches 80 to 100 deg., it will expand enough to cause some disturbance to the track.

If the track has many curves, the usual result is that the track is pushed outward on the curves. Not a few section foremen have been blamed by engineers who have been called on to rerun the center line, for lining the curve out "because that is the easiest way to line it", when the basic trouble was tight rail. If the track is on long tangents, the expanding rails will cause kinky joints, unless the joint bars have sufficient lateral stiffness to resist the lateral movement. If the excess length cannot be taken care of at the joints, kinks and wavy track will appear at other places.

Where rails with snow on them are laid tight while the temperature is well below freezing, it is entirely possible that during the hot days of the following summer, the rails will bow upward enough to permit one to shove his hand between the rail and the tie plate. Such cases usually develop into sun kinks, in which the entire track buckles sidewise far enough to relieve the pressure of the expanded rails. The only remedy in such an event is to cut rails at intervals or

(Continued on page 461)

\*This discussion was submitted for publication in the What's the Answer department in the July issue, but because of its scope it has been withheld for presentation here as an independent article. For further discussion of the subject see page 409 in the July issue.

# Floods Ravage Railways in Central New York

**Cause damage amounting to \$1,500,000 on seven roads as approximately 500 miles of tracks are affected by washouts and slides**

IN THE worst flood on record in the lower central part of New York State early in the week of July 7, a score or more towns were engulfed by the surging waters from as many streams, thousands of acres of farm land were inundated, highways were washed out and destroyed and more than 500 miles of tracks on seven different railways were affected by washouts, slides, debris blockades and bridge failures which completely shut off or demoralized train operation for from two to ten days in spite of the most strenuous efforts to restore normal service. The roads affected most seriously were the Delaware, Lackawanna & Western, the Erie, the Lehigh Valley and the New York Central, although the Delaware & Hudson, the Pennsylvania and the New York, Ontario & Western were damaged at many points. First estimates are that the total damage to the roads as a whole will reach \$1,500,000.

The Lackawanna alone expects that it will have to spend approximately \$500,000 to restore its property to pre-flood condition, and the damage

on the Erie, the Lehigh Valley and the New York Central, is estimated at \$420,000, \$300,000 and \$150,000, respectively.

The flood was the direct result of heavy general rains on July 6 followed by a series of cloudbursts during the late evening of July 7 and the early morning of July 8, which occurred over much of the central part of the state where the terrain varies from hilly to mountainous with numerous valleys and steep winding water courses. Many places reported upwards of 10 in. of rain over the weekend and the report of a meteorologist who was visiting at Hector, on the Lehigh Valley, sets the precipitation from 5 p.m. on the sixth to 7 a.m. on the eighth at 14.23 in., which is equal to nearly half of the average yearly precipitation in this section of the country.

## Delaware, Lackawanna & Western

The most severe damage on the Lackawanna occurred on its double-track main line between Painted Post and Kanona, a distance of approximately 24 miles, and on its Syracuse and Utica division over approximately 30 miles. In these territories, mile after mile of track was flooded, washed, severely scoured or covered with flood debris, the water covering the tracks to a maximum of

nine feet in one area. In addition, three bridges were put out of service and numerous culverts were damaged or fouled. At many points the tracks were left hanging in the air or had dropped into deep holes, and likewise at many points they were thrown far out of line. Lighter damage was experienced also on the road's Cincinnati and Ithaca branches.

The largest bridge affected was a two-span through truss structure approximately 280 ft. long, the center pier of which was undermined and settled. Here it was necessary to support the floor system of both spans on temporary pile bents at the panel points in order to restore train serv-



The Damaged High Viaduct of the New York Central at Watkins Glen, N. Y., Just Before the Second Track Fell

ice. At the other two bridges damaged, one of which consisted of a 35-ft. girder span and the second of two 60-ft. girder spans, it was necessary to drive temporary pile trestles to carry traffic until the necessary repairs can be made.

## Damage On the Erie

While the Erie was affected over approximately 180 miles of its main line from Binghamton west to Olean and over much of its single track Rochester division between Corning and Avon, a distance of approximately 75 miles, the major damage on this road occurred between Painted Post and a point just west of Hornell on the main line, approximately 40 miles, and between Painted Post and



One of the Main Line Bridge Openings Badly Washed on the Lackawanna

Kanona on the Rochester division, a distance of 22 miles. Throughout these sections high water, washouts and slides were common, the individual washouts ranging from 20 ft. to as much as 1,000 ft. in length and up to 20 ft. in depth, and the slides covering the tracks with mud, rock and gravel to depths of 3 to 4 ft.

At Hornell, where the road has approximately 72 miles of tracks in main lines and yards, as well as large shops and an engine terminal, the Canisteo river washed out a bridge and broke through the main line over a distance of approximately 600 ft., flooding the entire railroad plant. At one time, all of the tracks at this point were under from two to five feet of



Thousands of Feet of Tracks Were Washed Out as the Streams Overflowed and Broke Through the Roadbed

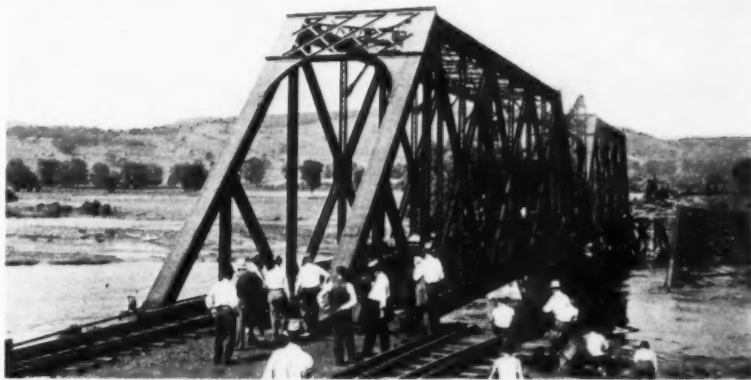
water and approximately 30 in. of water stood in the enginehouse and shop buildings.

Between Painted Post and Wallace on the Rochester division, a distance of 28 miles, there were from 40 to 50 washouts from 100 to 1,000 ft. in length, involving a total of approximately 27,000 ft. of track. Where the roadbed was not completely broken through, it was either badly washed or covered with flood trash.

### Lehigh Valley

The damage on the Lehigh Valley occurred almost entirely on its Buffalo division within a radius of approximately 50 miles of Ithaca, and affected approximately 26 miles of main line and approximately 120 miles on four branch lines. The damage on the main line, which began at Odessa, approximately 30 miles west of Sayre, Pa., and extended westward, included approximately 50 washouts, ranging from 100 ft. to 4,000 ft. in length and from a few feet to 50 ft., in depth, as well as 12 slides from 100 ft. to 600 ft. in length which covered the tracks to a depth of 2 to 3 ft.

On the Ithaca branch there was lit-



Two 150-Ft. Spans of the Delaware & Hudson Bridge Near Sidney, N. Y., Collapsed as a Part of the Center Pier Was Washed Out.

tle trouble with slides, but there were washouts at 59 points, generally less than 400 ft. in length and 5 ft. in depth, but including several up to 2,500 ft. long, and several as deep as 40 ft. On the Lehigh & New York branch, between Owego and Cascade, a distance of 53 miles, there were 67 washouts from 30 to 60 ft. in length and up to 12 ft. in depth, and on the Auburn & Ithaca branch approximately 110 additional washed sections, generally 250 ft. or less in length and a maximum of 10 ft. deep. On the latter branch, however, there were approximately 50 slides of various magnitudes, the largest covering approximately 600 ft. of track to a depth of from 1 to 9 ft.

In addition to the damage to the track on the Lehigh Valley, eight girder or I-beam bridges were injured or destroyed.

### New York Central

On the New York Central, the damage was confined largely to its double-track Pennsylvania division which extends north and south through the central part of New York state, although there were washouts on several of its branch lines, and one serious washout for a distance of about 300 ft. on the double-track West Shore at Randall. Between Beaver Dam and Himrods Junction on the Pennsylvania division, a distance of about 24 miles, there were more than a dozen deep washouts, and, in addition, the road lost the two center spans (170 ft.) of its two-track high steel viaduct over the gorge at Watkins Glen. At this viaduct, which lies approximately 150 ft. above the stream bed, the center steel tower was undermined and carried away, dropping the two spans into the gorge.

The most serious washouts on the Pennsylvania division occurred near Irelandville, where a 55-ft. fill was

completely washed out to its base for a distance of approximately 300 ft., and near Wedgewood, where a 40-ft. fill was cut through to the bottom over a distance of about 90 ft.

The Delaware & Hudson experienced minor washouts at widely scattered points, but its most serious loss was two 150-ft. through truss spans of its four-span bridge over the Susquehanna river near Sidney. Here, due to the collapse of the upstream two-thirds of the center pier, the two spans carrying northbound traffic fell into the river.

The damage on the Pennsylvania was confined to a few rather serious washouts on its line between Canan-dagua, N.Y., to Williamsport, Pa., while that on the New York, Ontario & Western included a number of minor washouts on its main line between Walton and Oxford, and on its Delhi and Kingston branches.

While train service was completely demoralized on the lines affected by the flood, each road marshalled its maintenance forces, work equipment and thousands of cars of materials in the flood territory and, working night and day, pushed the restoration work from as many points as possible, with the objective of restoring one track to service at the earliest possible moment.

Where washouts could be repaired quickly by filling them this was resorted to, but for thousands of feet the tracks had to be supported on timber cribbing, and at many points the only feasible means of prompt restoration of service was to drive temporary trestles or construct "shoo-flies." Although at least a single-track was available for service on the damaged sections of the different roads within from 2 to 10 days, and train operation was substantially normal by the last week in July, there still remains many evidences of the flood havoc, which will require months of work to remove.

## Volume of Wood Treated Increases Sharply in 1934

THE total quantity of timber given preservative treatment in the United States in 1934 amounted to 168,438,214 cu. ft., which represents an increase of 42,482,386 cu. ft., or 33.7 per cent, as compared with the quantity reported in 1933. Increases were registered in all of the eight classes of material treated, the largest percentage of increase being in wood blocks. Miscellaneous material ranked second and cross arms were third. Poles, piles, construction timbers, crossties and switch ties came next in the order named, none of which showed an increase of less than 25 per cent, as compared with 1933. These figures, together with the data to be given later, are taken from the annual statistical report on wood preservation in the United States in 1934, which was compiled by R. K. Helphenstine, Jr., Forest Service, United States Department of Agriculture, in co-operation with the American Wood-preservers' Association.

Crossties given preservative treatment last year totaled 28,459,587, as compared with 22,696,565 in 1933, a gain of 25 per cent. Of the total number reported, slightly more than half were sawed ties. During the year, 81,341,922 ft. b.m. of switch ties received preservative treatment, as compared with 65,163,331 ft. b.m. of this class of material during the previous year, a gain of approximately 25 per cent.

There was a marked increase in the volume of piles treated in 1934, the increase being 3,600,564 lin. ft. to bring the total for the year to 12,773,435 lin. ft., and representing a gain of 39 per cent over 1933. Almost 80 per cent of all piles treated

last year were southern pine, the total quantity of this species being 10,115,339 lin. ft. Douglas fir came second with 2,320,861 lin. ft., the remainder, 337,235 lin. ft., being made up of miscellaneous species.

For many years oak ties have ranked first in the number treated, with southern pine occupying second place. In 1934, this position was reversed and southern pine ties occu-

the total number that were treated.

Of the 28,459,587 ties treated during the year, 17,890,819, or 62.9 per cent were treated with creosote, either alone or as a coal tar solution; 8,887,936 ties, or 31.2 per cent, were treated with creosote-petroleum mixtures; while only 1,411,069 ties, or 5 per cent, were treated with zinc chloride, and 0.9 per cent were treated with miscellaneous preservatives.

Of the total number of ties treated, 19,224,818 were adzed and bored before treatment; 1,217,514 were bored but not adzed, 472,064 were adzed without being bored; and 7,545,191 ties, or less than 25 per cent, were neither adzed nor bored.

### Wood Preservation, 1909-1934

Year	Together with consumption of creosote and zinc chloride			
	Total Material Treated Cu. Ft.	Number of Crossties Treated	Creosote Used, Gal.	Zinc Chloride Used, Lb.
1909.....	75,946,419	20,693,012	51,426,212	16,215,107
1910.....	100,074,144	26,155,677	63,266,271	16,802,532
1911.....	111,524,563	28,394,140	73,027,335	16,359,797
1912.....	125,931,056	32,394,336	83,666,490	20,751,711
1913.....	153,613,888	40,260,416	108,378,359	26,466,803
1914.....	159,582,639	43,846,987	79,334,606	27,212,259
1915.....	140,858,963	37,085,585	80,859,442	33,269,604
1916.....	150,522,982	37,469,368	90,404,749	26,746,577
1917.....	137,338,586	33,459,470	75,541,737	26,444,689
1918.....	122,612,890	30,609,209	52,776,386	31,101,111
1919.....	146,060,994	37,567,247	65,556,247	43,483,134
1920.....	173,309,505	44,987,532	68,757,508	49,717,929
1921.....	201,643,228	55,383,515	76,513,279	51,375,360
1922.....	166,620,347	41,316,474	86,321,389	29,868,639
1923.....	224,375,468	53,610,175	127,417,305	28,830,817
1924.....	268,583,235	62,632,710	157,305,358	33,208,675
1925.....	274,474,538	62,563,911	167,642,790	26,378,658
1926.....	289,322,079	62,654,538	185,733,180	24,777,020
1927.....	345,685,804	74,231,840	219,778,430	22,162,718
1928.....	335,920,379	70,114,405	220,478,409	23,524,340
1929.....	362,009,047	71,023,103	226,374,227	19,848,813
1930.....	332,318,577	63,267,107	213,904,421	13,921,894
1931.....	233,334,302	48,611,164	155,437,247	10,323,443
1932.....	157,418,589	35,045,483	105,671,264	7,669,126
1933.....	125,955,828	22,696,565	95,180,709	4,991,792
1934.....	168,438,214	28,459,587	119,049,604	3,222,721

ried first place with respect to the number treated, with a total of 10,658,903, or 37.5 per cent of all ties treated. Oak ranked second with 8,580,548, or 30.1 per cent. The third in rank being Douglas fir, with 2,816,104 ties, or 9.9 per cent. Among the other woods represented were gum, beech, maple, birch, tamarack, lodge pole pine, ponderosa pine and elm in the order named. All other woods taken collectively amounted to only 162,546 ties, or 0.6 per cent of

In the case of switch ties, from the standpoint of quantity treated, oak ranked first with a total of 44,655,778 ft. b.m., or almost 55 per cent. Southern pine followed with 14,230,693 ft. b.m., or 17.5 per cent, and Douglas fir was third with 10,682,265 ft. b.m., or slightly more than 13 per cent.

During the year, 119,049,604 gal. of creosote was consumed, an increase of 33,868,895 gal., or almost 40 per cent, as compared with 1933. This is the largest consumption since 1931 and is larger than for any year prior to 1923, although it is well below the 226,374,227 gal. consumed in 1929, the peak year. Of the total in 1934, only 23,545,222 gal. was imported, 95,504,382 gal. being of domestic origin. There was a still further decrease in consumption of zinc chloride.

The quantity of petroleum consumed by the wood preserving industry in 1934 was 14,981,299 gal., as compared with 13,230,745 gal. in 1933, an increase of 1,750,554 gal. The consumption of miscellaneous salts increased from 627,201 lb. in 1933 to 805,150 lb. in 1934.

### Crossties (Number) Treated by Kinds of Wood and Kinds of Preservatives, 1934

Kind of wood	Treated with creosote <sup>1</sup>	Treated with creosote-petroleum <sup>2</sup>	Treated with zinc chloride	Treated with miscellaneous preservatives	Total	Per cent
Southern Pine .....	8,389,633	2,247,532	3,538	18,200	10,658,903	37.5
Oak .....	6,973,988	1,431,978	171,677	2,905	8,580,548	30.1
Douglas Fir .....	17,093	2,504,231	285,445	9,335	2,816,104	9.9
Gum .....	1,330,395	119,956	.....	.....	1,450,351	5.1
Beech .....	607,199	262,905	148,638	.....	1,018,742	3.6
Maple .....	293,501	305,828	304,910	.....	904,239	3.2
Birch .....	207,127	581,098	78,629	.....	866,854	3.0
Tamarack .....	.....	317,895	172,650	238,005	728,550	2.6
Lodgepole Pine .....	.....	691,740	.....	.....	691,740	2.4
Ponderosa Pine .....	.....	289,030	.....	.....	289,030	1.0
Hemlock .....	.....	.....	240,871	.....	240,871	.8
Elm .....	15,569	33,976	1,564	.....	51,109	.2
All other .....	56,314	101,767	3,147	1,318	162,546	.6
Total .....	17,890,819	8,887,936	1,411,069	269,763	28,459,587	100.
Per cent of Total .....	62.9	31.2	5.0	.9		

<sup>1</sup>Includes distillate coal-tar creosote, creosote coal-tar solution, refined water-gas tar and water gas tar solution.

<sup>2</sup>Includes distillate coal-tar creosote, creosote coal-tar solution, refined water-gas tar and water-gas tar solution in mixture with petroleum.

## What Ballast Discers Can Do

**This is an abstract of a report presented by the Committee on Maintenance of Way Work Equipment before the convention of the American Railway Engineering Association. As used here the term "discer" embraces equipment of all sizes, from the motor car equipped with removable disc wings to the large powerful machines provided with attachments for discing, blading and scarifying.**

THE last few years have seen much progress in the mechanical treatment of ballast shoulders. Both large and small machines are in extensive use.

The large units offer a choice of various attachments, each of which is most effective and economical in some one or more of the different classes of work. These accessories include

suits in low cost have been reported for this class of discer (which weighs about 1½ tons) in work on dirt and cinder ballasted track, and also in gravel that does not contain enough large stones to make it difficult to keep the discs down. The smaller discer cuts a uniform sod line and is useful for dressing up shoulders on track that is badly washed. It is also useful for following up the large five to eight-ton higher-speed discer, where light weeding that does not require the power of a big discer is desired.

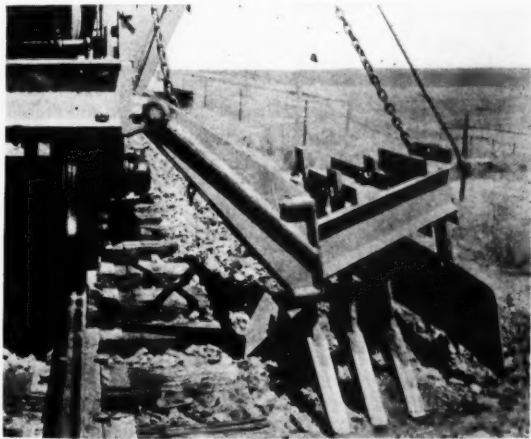
One type of machine equipped with scarifiers and bladers operates more economically than discs in rock ballast. These scarifiers have also been found so satisfactory in hard-caked foul gravel shoulders, where they are used primarily to improve drainage, that additional disc wings are not considered necessary, either for weeding or to form a slightly shoulder. One or two discs may be attached if it is desired to cut sod lines.

grade, thus aiding lateral drainage from the cribs. The scarifying wings on the larger units handle rock ballast or the most stony pit-run gravel shoulders without difficulty, whereas discs will tend to roll up to the top in such material. The wedge-shaped scarifiers bring large stones to the surface where they can be removed to avoid unnecessary wear and tear on light discers used for weeding.

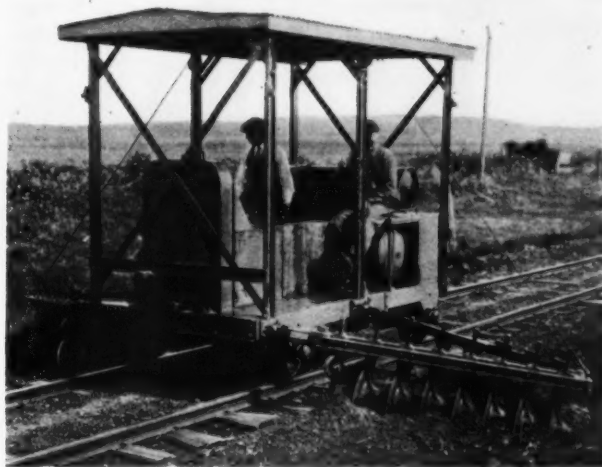
An important advantage of the scarifiers in both rock and gravel ballast lies in the fact that their use results in a sifting of the fine material to the bottom to a greater extent than is experienced with the use of discs. The more trips, the better the separation of the fine and coarse material and the greater the improvement in the drainage through the upper shoulder. The tie pockets are drained because the scarifiers undermine and clear the dams at the ends of the ties.

Weeding with scarifiers in gravel is producing good results, particularly on the heavy roots of such growths as quack, salt and Johnson grass. The points go deep enough to uproot and comb out the weeds and are less likely to cut the tops from the roots or bury the roots. The wings are raised by compressed air, so that bunched-up weeds and roots may be pulled off the points by hand as often as is necessary.

Regardless of whether these large traction units are operated with disc or scarifier wings, the cost of opera-



Above—A Scarifier Wing Attached to a Large Machine. At Right—The Same Machine Equipped With Discing Wings



discs, scarifiers and bladers employed in working over old ballast; and grader blades of suitable lengths to meet differing conditions in reballasting. Still larger machines shape ballast shoulders, roadbed shoulders and ditches to any specified standard section. They are operated by gas-electric power and are self-propelled.

The smallest machines are four-cylinder extra-gang motor cars temporarily fitted with disc wings for weeding, the disc wings of which may be removed so that the cars may be used for ordinary service when not needed as discers. Satisfactory re-

These scarifiers can be adjusted to open mud pockets around ties of standard length, but need not be lifted when they encounter an occasional tie that projects a few inches farther out. The inside scarifiers undercut only these projecting ties unless set to go farther in. Any desired depth and slope of cut from the ends of ties can be made. A comparatively smooth surface is left in the sub-

tion per mile is about half that of the smaller discers for the same work. The saving results from an ability to travel faster, to cut deeper, and to raise or lower the wings quickly by compressed air. The larger unit has an engine of 80 hp. or more, a four-speed transmission, and a heavy reverse gear for running either forward or backward.

(Continued on page 457)

Pitch and Gravel Roofs  
Are Particularly Adapted  
for Large Roof Areas  
Having Light Pitches



# Roofs—

## Constructing a Pitch and Gravel Roof

IN THEORY, the construction of a built-up roof is comparatively simple—the requisite number of plies of roofing felt and paper are laid and cemented together by mopping with hot bitumen, i.e., coal tar pitch or asphalt. In practice, however, the construction of a roof of this type is far less simple. The workmen engaged in the operation should be experienced. A

multitude of details require attention and an intimate knowledge of the materials and their limitations is highly desirable. For these reasons, the instructions contained in the manual for applying roofing of this type are especially complete. The rules covering the application of a pitch and gravel roof follow:

All materials shall consist of the

best grades and of approved brands.

Every container and every roll of felt or paper shall bear the manufacturer's brand and label. Rosin-sized sheathing paper shall weigh not less than 6 lb. per 100 sq. ft. Tarred felt shall be coal-tar-saturated rag felt 32 in. wide. It shall weigh not less than 15 lb. per 100 sq. ft. and shall contain approximately 60 per cent and 40 per cent of tar and felt, respectively.

Insulation shall be of the proper density for the use for which it is intended and shall be in the form of sheets of such size as are recommended by the manufacturer for this purpose. The sheets shall be  $\frac{1}{2}$  in. thick.

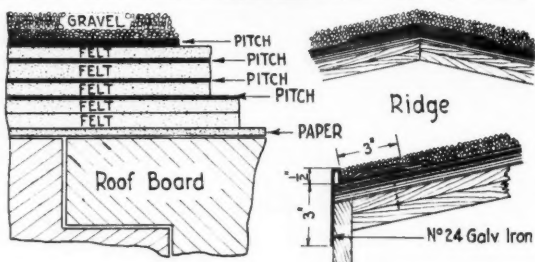
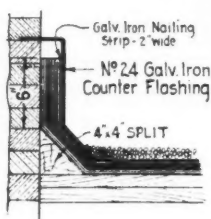
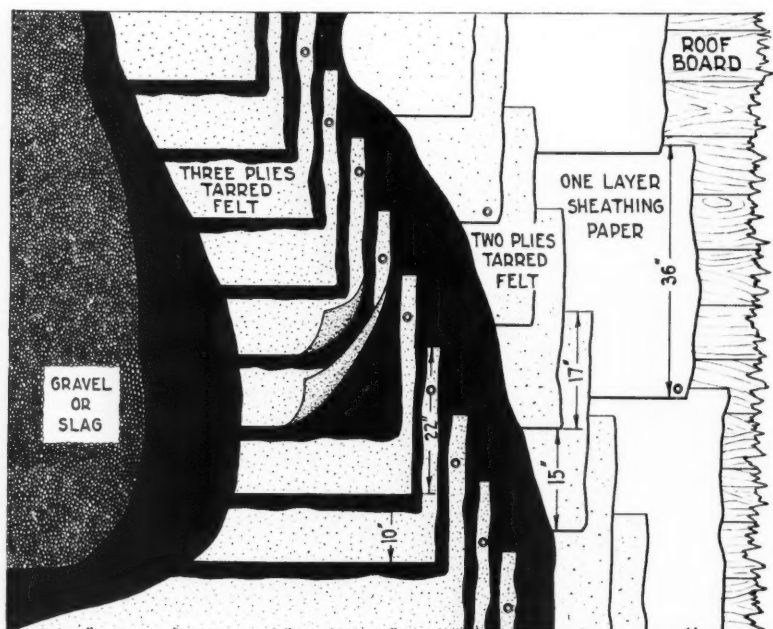
Pitch shall be of proper consistency for roofing purposes. It shall be straight-run pitch obtained wholly from the distillation of coal tar and shall meet the requirements of the United States Government's Master Specification R-P-381 for coal-tar pitch for roofing.

### Roofing Cement

Plastic roofing cement shall consist of asphalt containing asbestos fibre and shall be of such consistency as to permit its being worked with a putty knife or trowel.

Gravel, crushed stone or slag shall be free from dirt and shall range uniformly from  $\frac{1}{4}$  in. to  $\frac{5}{8}$  in. in size.

Nails for fastening down felt and gravel stops or other sheet metal shall



Roofing Details for the  
Application of a 5-Ply  
Tar and Gravel Roof  
over a Wood Deck

This article, which is the seventh in a series that was begun in the January issue, refers to that class of built-up roofing that is constructed with coal-tar pitch. It is taken from the manual of roofing practices which the Northern Pacific has issued for the guidance of its building forces and which was fully described in the initial article of the series.

be galvanized, barbed, 1 in. long, 12 gage and with heads not less than  $\frac{1}{4}$  in. in diameter. Where the nailing is to be done through insulation, the nails shall be 2 in. long. Nails for fastening down insulation to wood roof decks shall be galvanized, barbed, 2 in. long, 10 gage and with heads not less than  $\frac{7}{16}$  in. in diameter.

Tinned discs or caps shall be of the raised type not less than  $1\frac{1}{4}$  in. in diameter.

Counter flashing, gravel stops or other necessary sheet metal that is used shall be 24 gage, galvanized iron of an approved brand.

### General

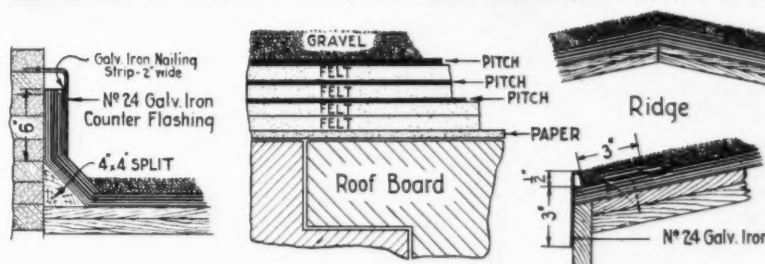
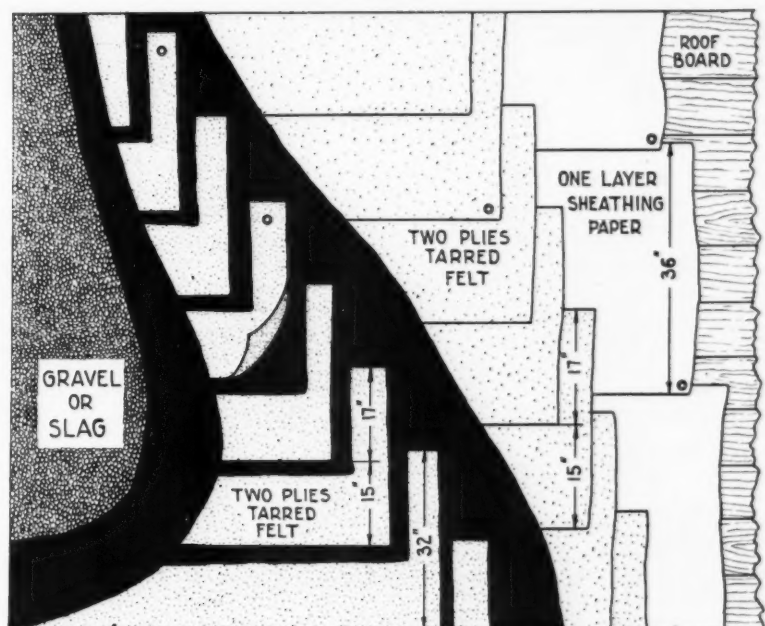
While being heated, the pitch shall be stirred frequently to prevent burning. It shall not be heated above 400 deg. F., or cut back or diluted with tar or other substitutes.

The sheathing paper and felt shall be laid without wrinkles or buckles.

All felts shall be laid so that the direction of the flow of water is over or parallel to the lap and never against it.

Pitch shall be applied so that the felts are fully embedded therein to their entire width and so that in no place shall felt touch felt, except as otherwise provided. Approximately 30 lb. of pitch per 100 sq. ft. of roof shall be applied in mopping between felt or between layers of insulation and not less than 60 lb. shall be used as the top-coating in which the mineral surface is embedded. The felts shall be broomed in while the pitch is hot and any blisters or puckers shall be pierced with the point of a knife to release the air and then broomed down.

Mineral surfacing shall be dry when applied and if the work is being



Four-Ply Tar and Gravel Roof over a Wood Deck

done in cold weather, it shall be heated sufficiently to insure that it is properly embedded in the pitch.

All nails used for fastening paper or felt shall be driven through tinned discs.

A five-ply pitch and gravel roof shall consist of one thickness of rosin-sized sheathing paper, five thicknesses of tarred felt and for each 100 sq. ft. of completed roof not less than 150 lb. of pitch and not less than 400 lb. of gravel or 300 lb. of slag.

### Five Ply Roofing

Built-up roofing of five-ply construction shall be applied over wood roof decks as follows: Over the entire roof deck lay one thickness of sheathing paper, lapping the sheets not less than one inch. Extend this paper to the tops of the fillets only, and nail sufficiently to hold in place until succeeding layers are applied.

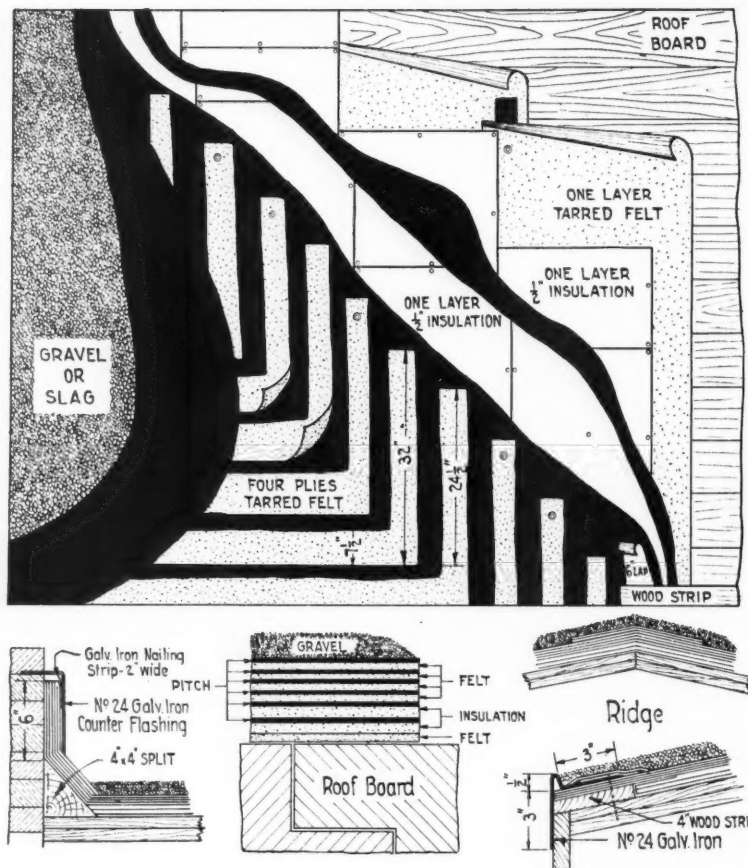
Over the entire surface of the sheathing paper lay two full thicknesses of tarred felt, lapped 17 in., thus leaving 15 in. exposed, and extend 6 in. up all vertical surfaces to be flashed. Nail each sheet sufficiently to hold it in place until succeeding

layers are applied. These are known as dry sheets.

Over the entire surface of the sheets apply a mopping of pitch, into which, while hot, three thicknesses of felt shall be embedded, each thickness to overlap the previous sheet 22 in., leaving 10 in. exposed. Extend this blanket six inches up all vertical surfaces to be flashed.

Solid moppings of pitch shall be applied between the thicknesses of this three-ply construction, so that at no point shall felt touch felt. Nail each thickness at the top edge at intervals not to exceed 24 in. Mop the turned-up portions to the dry sheets and also to the vertical surfaces, with hot pitch.

Place an extra double-thickness of felt, made by folding a sheet in the center and cementing it together with pitch, so that it extends up along all vertical surfaces to the height of the other sheets with the remaining portion extending out onto the roof surface and mop it in place with pitch. This provides seven thicknesses of felt against all vertical surfaces. Fasten all of these felts to the walls or other surfaces, nailing along the top edge on 12-in. centers through a



Four-Ply Tar and Gravel Roof Over Insulation on Wood Deck

strip of sheet metal 2 in. wide. This will constitute the base flashing.

Over the base flashing set a counter flashing of galvanized iron, bent into the brick joints or other groove that may be provided, immediately above the base flashing, and securely wedge and cement in place. The counter flashing shall be wide enough to extend down to the top of the fillet. The foregoing procedure shall be followed around skylights or other projections through the roof surface, except that on these surfaces counter flashing may be omitted where not necessary.

In addition to the foregoing, apply two thicknesses of full-width felt on ridges, mopping them to the roof and to each other.

Place gravel stops in accordance with the details shown in the drawing, along eaves and gables, attaching them securely at intervals of not to exceed three inches with nails driven one-half inch from the inside edge. One thickness of felt three inches wide shall be mopped with pitch to seal it to the gravel stop and the roof surface for the purpose of covering the nails. It shall be so placed that one inch of its width projects onto the felt, while the remainder is on the

stop. Over this place one additional thickness of felt four inches wide, so that it projects one-half inch on each side of the first strip, and mop it into place with pitch.

Over the entire surface pour from a dipper a uniform coating of pitch amounting to not less than 60 lb. per 100 sq. ft. While hot, embed into this pitch not less than 400 lb. of gravel or 300 lb. of slag, evenly distributed, for each 100 sq. ft.

Four-ply tar and gravel roofing is constructed in substantially the same manner as the five-ply roofing, the principal difference being that the strips of felt which are to be mopped on are lapped 17 in. instead of 22 in., thus leaving 15 in. exposed. For this reason and to avoid repetition, only a part of the instructions covering the four-ply construction are given. The requirements for nailing, mopping, flashing, gravel strips and the application of gravel are the same.

A four-ply pitch and gravel roof consists of one thickness of rosin-sized sheathing paper, four thicknesses of tarred felt and on each 100 sq. ft. of completed roof not less than 124 lb. of pitch and not less than 400 lb. of gravel or 300 lb. of slag.

The instructions for placing the

rosin-sized sheathing paper and the two layers of dry sheets are the same as for the five-ply construction.

Over the entire surface of the dry sheets apply a mopping of pitch into which, while hot, there shall be embedded two thicknesses of felt, each thickness to overlap the previous one 17 in., thus leaving 15 in. exposed, extending it 6 in. up all vertical surfaces to be flashed.

The remaining provisions are identical with those for the five-ply construction.

Where a roof to which built-up pitch and gravel roofing is to be applied is also to be insulated, the design of the roof differs materially from that in which the roofing is applied directly to the sheathing. In this case, the rosin-sized paper is omitted and one ply of dry felt is inserted between the sheathing and the insulation. The four-ply, built-up roofing is then applied over the insulation. The instructions for applying this form of construction follow:

Where pitch and gravel roofing is applied over insulation on wood deck roof construction, there shall be used one thickness of tarred felt under the insulation, two thicknesses of  $\frac{1}{2}$ -in. insulating board, four thicknesses of tarred felt over the insulation, and for each 100 sq. ft. of completed roof not less than 210 lb. of pitch and not less than 400 lb. of gravel or 300 lb. of slag.

Wood strips of the same thickness as the insulation and four inches wide should be installed flush with the edge of the roof deck at all eaves and overhanging gable ends, to act as a stop for the insulation.

One thickness of tarred felt should be laid with all sheets lapped six inches. These laps should be sealed with pitch and nailed sufficiently to hold in place. In sealing the laps, keep the pitch mopping back two inches from the edges so that no pitch will run over the felt and seep through the wood deck. At all edges, extend the tarred felt seven inches beyond the inner edge of the wood strip but do not fasten it down. These edges are later to be sealed down over the insulation.

Over this layer of felt, the roof should be covered with two thicknesses of  $\frac{1}{2}$ -in. insulation. The first layer should be tacked in place with one-inch nails. The second layer should be embedded in hot pitch over the first layer and laid in such manner as to break joints in both directions with the first layer. The tightness of the joints at the edges should be in accordance with the recommendation of the manufacturer. The two layers of insulation should then

be secured to the sheathing by nailing through the top layer along the edges and through the center of each sheet, spacing the nails 12 in. center to center and staggering the center row of nails. After the insulation is in place, the up-turned edge of the underlying felt should be turned back and mopped in place to seal it to the insulation. Insulation should not be exposed to the weather and no more should be laid in one day than can be covered with the roofing felt before the close of the day's work.

Over the entire surface of the insulation and edging strips apply a mopping of pitch into which, while hot, there shall be embedded four thicknesses of felt. Each thickness of the felt should overlap the previous thickness  $24\frac{1}{2}$  in., leaving  $7\frac{1}{2}$  in. exposed—for sheets 32 in. wide—and extend 6 in. up all vertical surfaces to be flashed. Solid moppings of pitch should be applied between the succeeding thicknesses of this four-ply construction so that at no point should felt touch felt. Nail each thickness at the top edge at intervals not to exceed 24 in., using nails 2 in. long.

The remaining provisions for flashing, ridge construction, gravel stops and gravel or slag surfaces are the same as those for the four and five-ply construction previously given; therefore they are not repeated here.

While under normal use a properly constructed tar and gravel roof should require practically no maintenance for many years, cases do occur, sometimes as the result of external causes, where leaks develop. As the service life of the roofing is extended, however, repairs will be needed with increasing frequency. Even at this stage, however, such a roof can be continued in satisfactory service at a relatively low cost if given proper attention at the right time. The rules for doing this are set forth in the manual as follows:

A properly constructed pitch and gravel roof should require little or no maintenance for a considerable period, and it should give at least 25 years' satisfactory service before reconstruction is necessary. If leaks do develop, they should be repaired by removing the pitch and gravel down to the felt, which should then be reinforced by two or three additional layers of felt. Each layer should overlap the other by four inches around all edges. Each one should be embedded in pitch and the top coating of pitch and gravel replaced. Periodic inspection should be made and any trouble detected should be corrected before it assumes serious proportion.

After a period, and for various reasons, bare spots will develop in the mineral coating. When this occurs, these spots should be cleaned off, examined and repairs made if found necessary.

Eventually the lighter oils in the pitch will evaporate and the felt will begin to dry and leaks will occur with greater frequency. Finally, the stage will be reached when patching becomes no longer advisable. At this point the proper action is to strip off the pitch and gravel top surface so that the condition of the felt can be observed. If it is thoroughly dried out, brittle and cracked, new roofing will be necessary. If it is found to be in fair condition, however, the life of the roof may be extended enough to justify adding one or two thick-

nesses of new felt thoroughly mopped on and the replacement of the pitch and gravel.

When removing the pitch and gravel, the gravel should be raked and swept into piles. It should then be cleaned by screening before it is replaced and any shortage made up with new material.

Pitch should be removed with heavy spades. If the work is to be done during warm weather, this part of the operation should be taken care of as early in the morning as practicable while the pitch is brittle from the cool of the night.

All flashing and roof drain connections should be checked, broomed off and remopped with pitch.

New pitch should always be used for mopping and recoating.

## What Ballast Discers Can Do

(Continued from page 453)

Fitted with scarifiers, the larger units are not only employed in gravel but are being used to an increasing extent on rock-ballasted track to break up foul cemented shoulders and re-establish drainage. Several trips are made, each cut being deeper than the preceding one, the last cut being below the level of the bottoms of the ties. However, the ends of the ties are not undercut, if the track is to be left open a few days to dry out. The scarifying piles the rock a foot or two away from the cribs and thoroughly agitates it and rubs the pieces together, thereby loosening much of the dirt and sifting it to the bottom.

The scarifying wings are then chained up and blader wings are let down to restore the rock to approximately the standard shoulder section (if there is enough of it). The dirt settles toward the bottom of the cut, where rain helps to wash it out to the ballast toe line. Where the roadbed shoulder is too high, the loosened rock constitutes a sort of "French drain" parallel to the track, and cross drains cut at intervals along the shoulder afford outlets down the slope.

The scarifying of rock ballast shoulders for crib drainage increases the use which can be made of the larger units. Scarifiers are superior to discs for drainage purposes in badly cemented ballast because they move faster and effect a more positive opening of the ends of tie pockets by undercutting the "dam" at the ends of the projecting ties.

The committee makes no recom-

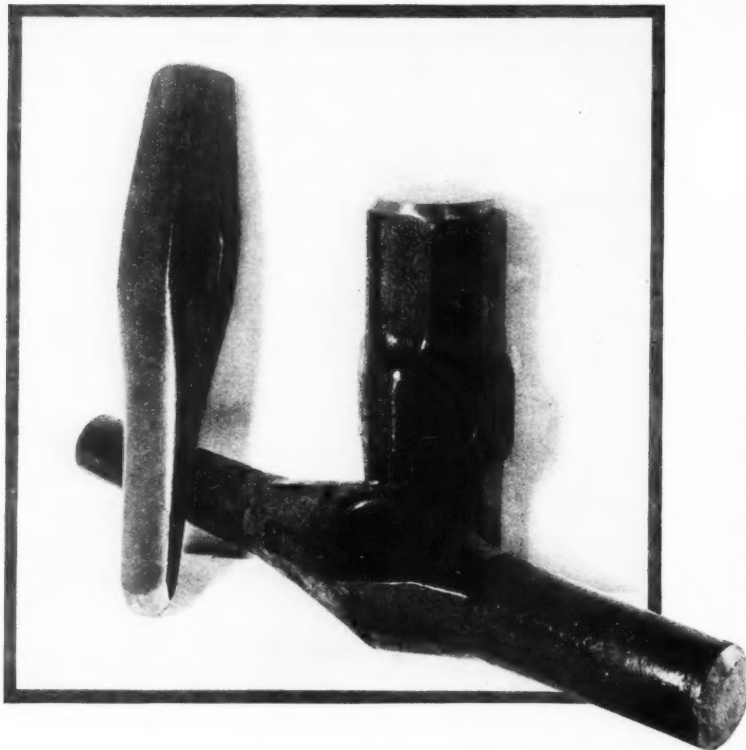
mendation, with respect to the replacement of discs with scarifiers in uniformly fine ballast such as cinders or screened gravel for local conditions such as rainfall, nature of the vegetation, and the frequency of the shoulder treatment, may require the use of either.

The scarifier and disc wings are readily interchangeable on the large units, making it possible to keep the machine busy the year around where the climate permits.

Scarifiers and discers are on a par as to the shaping of the ballast; either one can do a good job with the quantity of ballast on hand, giving the shoulder a practical slope and a more uniform appearance than it had before discing. Scarifiers have the advantage of an adjustable blader wing which can be made to do finer work than the discs.

### Conclusions

1. Ballast discers of both the large and small type are used extensively in the treatment of ballast shoulders.
2. The smaller machines are adapted particularly for work in dirt, cinders and gravel ballast, for cutting the sod line and for light weeding.
3. The large machines operate both discs and scarifiers for cleaning ballast and removing mud pockets. The operation of the larger machines with discs is also more satisfactory than the smaller machines in rock and slag ballast, or in gravel ballast where large stones make it difficult to keep the discs down.



**SPIKE MAULS**, sledges and chisels comprise a distinct group of track tools that have a number of characteristics in common. Although in design and use they bear little relation to other track tools, they are an important and necessary part of the equipment of every track gang. Each of these tools is simple and is used for a specific purpose. Of the three, probably no tool, except the track shovel, is used more frequently in track construction and maintenance than the spike maul, while it and the chisel are bought in larger numbers than any other tool, except the shovel.

### Sledges

Previous articles of this series have dealt with tools and materials for which many diverse designs are in use. When we turn to these so-called percussion tools, we find a different picture. The number of designs for sledges has never been very great, except for differences in weight, and in recent years this tool has been reduced to substantially a single design, except that six weights, ranging from 6 to 16 lb. are still demanded. Practically the entire production of sledges now conforms to the A.R.E.A. designs, about 80 per cent of the orders for track tools being for the 8-lb. and 12-lb. sizes, and 10 per cent for the 10-lb. size. In addition, many orders from the mechanical department call for the 16-lb. size of the A.R.E.A. design.

Since sledges have been reduced to practically a single design, the manufacturer is able to make up a stock from which he can fill orders for most of his customers. As a rule, there are no specifications covering the steels from which sledges are made, the only requirement being that the tools shall pass certain physical tests. Yet a few roads specify the composition of the steel, as well as the physical tests, and as these all differ, it is necessary to carry a considerable stock of bars to meet these special requirements. Furthermore, these varying chemical requirements make it impossible for a manufacturer to make up stocks for these roads, so that small orders tend to increase the cost per tool.

Over a long period, the designs for spike mauls have been numerous and diverse. Although all of these differences have not yet been reconciled, the number of designs in use at present is relatively small. About 80 per cent of the production conforms to A.R.E.A. designs, which come in three different weights, although some 10 roads still follow their own designs, some of which are ordered in two or more weights. For this reason, manufacturers are still called on to make from 15 to 20 designs differing from those of the A.R.E.A.

Furthermore, certain roads, some of which use the A.R.E.A. designs, require the edge of the striking face of spike mauls to be ground to a designated radius, usually  $\frac{1}{8}$  in. As

This is the ninth article of a series dealing with the number and diversity of designs for track materials and tools. The first article, in the November issue, presented the general problems of standardization. In the succeeding issues, except March, the specific problems connected with rail, track wrenches, tie plates, lining, tamping and claw bars, rail joints, adzes and bolts and nuts, have been discussed. Track spikes will be the subject of the next or tenth article.

this is a manual operation which requires exact workmanship, it consumes considerable time and, therefore, adds materially to the cost of manufacturing the tools.

### Special Designs

A manufacturer can safely make up a stock of spike mauls representing the 80 per cent of his production which conforms to the A.R.E.A. designs, from which he can ship as orders for these tools come in. Since the remaining 20 per cent is made up of special designs, he is not in position to make up a stock from these designs, especially since experience has taught him that they may be discontinued or changed without notice, in which event he would be left with a stock of unsalable tools on his hands.

A set of forging dies for spike mauls costs about \$500 and a different set is required for each design and weight of this tool. It costs \$10 to change these dies in the machines. While the cost of press dies is somewhat less, the cost of making a change is \$30. These figures represent only the actual labor cost of making the change and do not include the loss of production of the machines or the slowing down of other shop operations which are dependent on the continuous operation of the forging machines. The cost of loss of production alone frequently exceeds the labor cost.

## Spike Ma

Sm  
made  
prob  
thoug  
shipp  
some  
design  
costs  
der f  
sign  
for c  
loss  
of m  
befor  
eration  
as pr  
crease  
alone

### Chis

For  
signs  
gave  
than  
unifo  
For t  
velop  
fort  
satisf  
Alt  
at fa  
deepe  
made  
of w  
judgm  
tor.  
unifo  
be exp  
specia  
trol c  
pering  
elimini  
is pos  
use c  
heat  
spond  
formi  
The  
ture  
the in  
for c  
numb  
been  
mean  
have  
still i  
bulk  
the A

# Mauls, Chisels and Sledges— Can They be Standardized?

Small orders for tools that can be made up in advance are not a major problem with tool manufacturers, although it is obvious that the cost of shipping and accounting is increased somewhat. Small orders for special designs do increase manufacturing costs materially, however. If an order for six spike mauls of special design requires an expenditure of \$10 for changing dies and results in a loss of \$10 production time, a cost of more than \$3 a tool has accrued before the actual manufacturing operation has begun. If they are made as press forgings, this cost is increased to \$5 a tool for changing dies alone, creating a loss at the start.

## Chisels

For many years the number of designs for track chisels was great. Few gave satisfactory service and, more than any other device, they lacked uniformity with respect to quality. For this reason, individual roads developed design after design in an effort to get a tool that would give satisfactory results.

Although designs were sometimes at fault, the basic trouble went deeper. Until recently, chisels were made of carbon steel, the tempering of which was subject only to the judgment of the heat-treating operator. Under these circumstances uniformity of quality could scarcely be expected. With the introduction of special alloy steels and automatic control of heating, quenching and tempering, the personal equation has been eliminated and uniformity of quality is possible. While some roads still use carbon-steel chisels, controlled heat treatment has made a corresponding improvement in the uniformity of this product.

These improvements in manufacture have eliminated, in large part, the incentive to develop new designs for chisels, with the result that the number of designs in current use has been greatly reduced. This does not mean, however, that all differences have been eliminated, for a few roads still insist on their own designs. The bulk of the production conforms to the A.R.E.A. designs, although a

number of roads which accept the A.R.E.A. designs for the head and eye demand a point (the section of the tool below the eye) of different design.

While a manufacturer can safely make up a stock of track chisels to A.R.E.A. designs, to fill orders for those of his customers who accept these designs and specifications, two principal difficulties are encountered. The first, which has been mentioned, is that not a few roads demand points differing from the A.R.E.A. designs. While this creates no particular difficulty in plants using the drop-forging process, as the dies for shaping the points can be changed in 15 min., it does add to the cost of the tools, particularly if the order is small, since stocks cannot be made up in advance of the order.

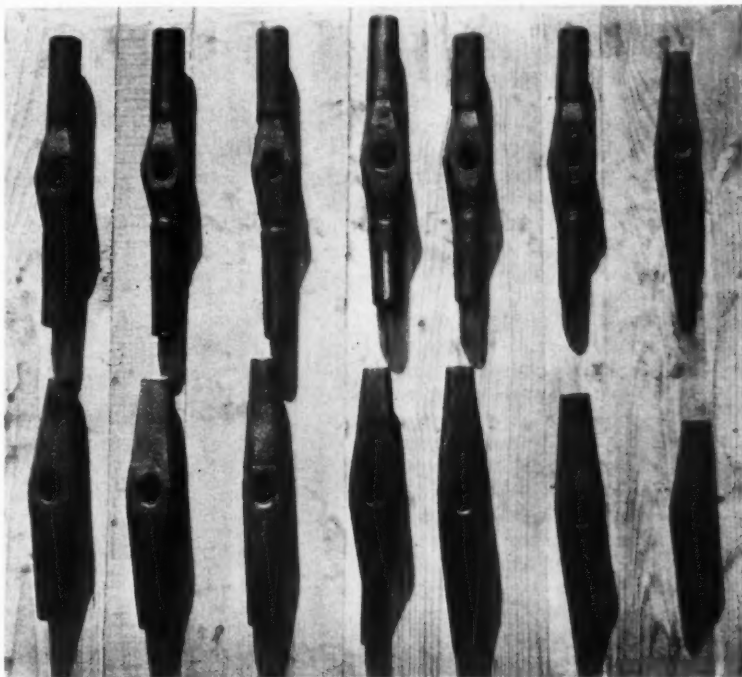
In plants making press forgings a more difficult problem is created, for the entire chisel, except the eye, is shaped in one operation, for which reason a separate die is required for each change in the design of any part of the tool. As the cost of changing

dies is \$30, the cost per tool for small orders may be prohibitive.

More important than these differences in design, different roads specify different chemical analyses for the steel from which chisels are made. Obviously, a manufacturer cannot wait until an order for chisels is received to order his bar stock. Furthermore, in addition to the necessity for ordering this stock in advance, he must order a sufficient quantity to make a rolling practicable. Because of this diversity in specifications, a manufacturer must carry a large inventory of bar stock if he is to be prepared to fill orders within a reasonable time after they have been received.

## Physical Tests

Most of the roads, even including a number of those which do not accept the A.R.E.A. designs for spike mauls and chisels, some of which have their own specifications for the chemical properties of the steel, follow the A.R.E.A. specifications with respect



No Two of These 14 Spike Mauls Are of the Same Design

to the requirements for physical tests. Under these specifications, one spike maul or sledge is selected from each lot of 20 doz. or less and must stand "1,000 full swinging blows for open-hearth steel or 3,000 full swinging blows for alloy steel, by hand striking, or the mechanical equivalent, on a die block having a Brinell hardness of 400, without undue mushrooming or cracking of the face or edge of mushroom."

Likewise, one chisel is selected from each lot of 20 doz. or less and must be tested "by cutting 100 linear inches in a rail head having a Brinell hardness of 260, by mechanical or hand striking approximating service conditions, to a depth of 3/16 in. below the original surface. In addition, three gouging blows shall be struck, of such intensity as to give for each blow a cut approximately 1/16 in. deep. The chisel point shall stand this test uninjured and the head shall stand up without undue battering."

### Tests Costly

It is not the purpose to criticize these requirements or to imply that they are too severe. In fact, every tool manufacturer is able to meet them. Yet these tests enter definitely into the cost of making the tools. The manufacturer must provide the labor for doing the striking and, in the case of chisels, for holding the test chisels while the cuts are being made. Furthermore, since one man is unable to strike continuously the number of blows required in any of these tests, two and often three, men must be assigned to wield the maul or sledge until the test is completed. It is not uncommon for any of these tests to cost as much as \$15 to \$18. If the order calls for 6, 12 or 18 tools, as many orders do, it is obvious that the cost per tool may be unreasonably high.

In view of the fact that every reputable manufacturer stands back of his products and replaces any tool that is found to be of inferior quality, it would seem that these relatively severe and expensive tests might safely be waived for small orders. If it is not desired to waive them completely, it might be possible to conduct one such test at some unexpected time, for each aggregate lot of approximately 20 doz. tools.

These facts disclose that while designs for spike mauls, sledges and chisels have been greatly simplified, their manufacture has not yet been reduced to a basis that results in minimum cost of production. The reasons for this are found, in part, in the diversity of requirements for the steel from which they are made. Another

factor which increases the cost of production is that not a few roads, while accepting the general features of the A.R.E.A. designs, insist on minor variations, which have the effect of creating new designs, preventing the tools from being made up in advance. Again, small orders for tools which cannot be made up in advance are another factor in increasing production costs, owing to the expense of changing dies and of carrying out the physical tests that are demanded.

In view of the reduction already made in the designs for spike mauls, sledges and chisels, it would appear pertinent to inquire whether these tools cannot now be completely standardized? This has practically been accomplished with sledges, primarily because there never has been a multiplicity of designs for this tool. It would seem possible to go even a step farther and eliminate the 6 and 14-lb. sizes, since the demand for these weights is almost negligible. While the number of designs for spike mauls and chisels has not been reduced to the same extent, there are no fundamental differences in the several designs now in use. In fact, all designs have certain features in common, such as the eye, which is the same in all designs in both spike mauls and chisels, and such variations as do occur are minor in character. On the surface, at least, there seems to be no reason why these tools cannot be standardized in accordance with the A.R.E.A. designs.

### Will They Accept?

Will the roads be willing to accept rigid standards for these tools? Spike mauls and chisels afford an excellent illustration of the reluctance of many railway engineers to accept

standards on the ground that it will restrict their freedom to choose those designs which they believe are best adapted for their particular needs. On the other hand, where a standard, say for spike mauls, is acceptable to all but 10 or a dozen roads, it is difficult to understand what conditions make it unacceptable to this small minority.

Reluctance on the part of some roads to accept designs that are satisfactory to all but a few has its parallel in the wide diversity of chemical requirements for the steel from which these tools are made. Since the physical tests which are specified by practically all roads are severe enough to insure good tools, it would scarcely seem necessary to have so many different chemical requirements, all of which are admittedly intended to produce the same results with respect to quality.

Is complete standardization necessary for economy? In the tools under discussion, standardization has been more nearly achieved than for any other of the track materials or tools that have heretofore been discussed. Yet there still remain many minor variations in design, as well as diverse requirements for the composition of the steel from which these tools are made, which create substantially the same situation with respect to economy of production that would be created by an equal number of widely divergent designs. Since no fundamental differences from the generally accepted designs, or variation which affect the utility of the tools, can be found in these departures, this seems to be a case where complete acceptance by all of the roads of the A.R.E.A. designs and specifications for spike mauls, sledges and chisels is the logical way in which maximum economy can be obtained.



A Modern Passenger Train Crossing the 90-Year-Old Thomas Viaduct of the Baltimore & Ohio at Relay, Md.

## Maintaining a Turntable\*

By H. S. Loeffler

Bridge Engineer, Great Northern, St. Paul, Minn.

AN ADEQUATE and dependable turntable is perhaps the most important of all of the numerous facilities that are required for the successful operation of an engine terminal, for which reason, proper methods of maintenance to insure uninterrupted operation are equally important. The ability to maintain a turntable so that it will always be in condition for satisfactory service does not necessarily depend on the alertness of those who are charged with its maintenance, for many of the difficulties encountered can be avoided by installing a turntable of adequate size and strength, with foundations capable of support-

tracks approaching the pit be fastened securely to the top of the curb wall. Likewise the rails on the turntable should be anchored securely, especially at the ends, to eliminate any chance of longitudinal movement. If a locking device has been provided, it should be maintained in working condition, as this will reduce the hazard of derailment.

If the turntable is of the balanced type, sufficient clearance must be maintained between the end carriage wheels and the top of the circle rail, so that the end wheels at one end will always clear the circle rail while the locomotive is being turned. The practice of tightening the end truss rods for the purpose of raising the ends of the table should be discouraged. It is better to raise the turn-

proof grease, of a grade that does not harden in cold weather, and if a small amount of this grease be added from time to time, it will not be necessary to clean out the center bearing for several years. The other working parts of the turntable, including the tractor, should be lubricated with either oil or grease at regular intervals as may be required.

It will be necessary to clean and paint the various parts of the turntable at frequent intervals. In general, however, it is best to maintain the paint on a turntable by spot painting, rather than by complete painting from time to time.

## Laying Rails Tight

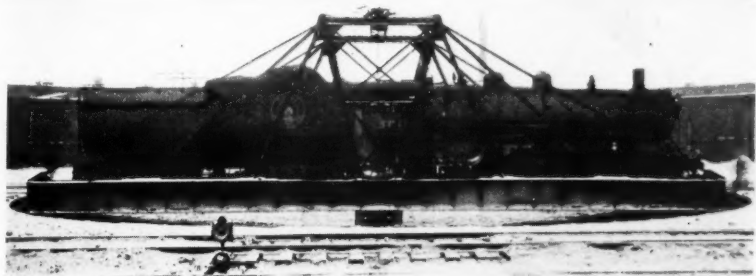
(Continued from page 449)

remove rails at these intervals and substitute shorter ones.

It is doubtful whether there is any advantage in laying rail tight, for tight rail develops more chipped ends with consequently greater batter and the necessity for more frequent surfacing of the joints. The net result is more damaged rails, rougher riding track, greater danger of derailments and higher maintenance costs than where the rails are laid with the correct amount of opening at the joints to care for the unavoidable expansion. The only advantages that can be claimed are less noise, or wheel click, at the joints and possibly a slightly smoother passage of the wheels over the joints while they are still new. The bad line and surface that results during hot weather will increase the rough riding of the track occasioned by kinks and bends, more than the tight joints will improve it.

In addition to the foregoing disadvantages, another, serious in character, is the difficulty experienced by trackmen in surfacing or otherwise disturbing the track during warm weather because of the danger of the track buckling from sun kinks whenever it is disturbed. Again, a much heavier ballast shoulder must be maintained to prevent kinking, which not only increases the investment in ballast, but retards drainage, again increasing maintenance costs.

Many derailments, not a few of which have been serious, have been caused by sun kinks which, in turn, have resulted from laying the rail tight or having allowed it to creep toward and bunch in sags until it was tight. Unless the track is to be buried, as in paved streets or in similar construction, it is my judgment that it is not good practice to lay rails tight, regardless of their weight or section.



A Modern 100-Ft. Turntable on the Great Northern

ing the dead load of the structure and its live loads.

An ample foundation under the curb wall and circle rail is just as important as the foundation under the turntable center. Both of these foundations should be carried down below the frost line, and be supported on piles, if they are necessary to provide the proper support. The placing of a small amount of steel reinforcement in concrete foundations is a good investment. Even a slight settlement of either the curb-wall and circle-rail foundation or the center foundation is sure to cause trouble.

Adequate drainage should be provided for the turntable pit. A catch basin of sufficient size to catch and hold cinders and other debris that might clog the sewer should be provided at the low point of the pit.

It is desirable that the rails of the

table itself by inserting the proper thickness of steel shims on top of the center bearing. The truss rods should always be adjusted, however, so as to maintain the main girders in a straight line.

Proper attention to lubrication is an item that should not be overlooked.

If the center bearing is of the roller type, the roller compartment should be filled completely with waterproof grease. Grease lubrication is far more satisfactory than oil for bearings of this type, because the grease prevents water and dirt from entering the roller compartment. If oil is used, it is likely to be displaced by water that may enter the center bearing, thus resulting in badly corroded rollers and treads. Furthermore, during cold weather, this water will freeze in the roller compartment and, besides causing difficulty in turning the table, may damage the roller nest.

Kerosene or alcohol should never be used to prevent the freezing of the center. If the center bearing is lubricated properly with a good water-

\*This discussion was submitted for publication in the What's the Answer department in the July issue, but because of its scope was withheld for presentation here as an independent article. For further discussion of this subject, see page 408 of the July issue.

# What's the Answer?



## Which Is More Difficult to Line?

*Is it more difficult to line track that is newly surfaced or track that has not been raised? Why? Which will hold the line better? Why?*

### Some Raise Preferred

By J. R. WATT

Engineer Maintenance of Way, Louisville & Nashville, Louisville, Ky.

Generally speaking, track that is newly surfaced is more easily lined. The reason for this is that there is some tendency for every kind of ballast to bed itself into the bottom of the tie. This is more pronounced with the coarser types of ballast, such as rock or slag, so that some raise is practically necessary for the lining operation where such materials are used for ballast.

There should be little difference with respect to which will hold the line better. Where track that has not been surfaced is lined only a short distance, there will be a tendency to work back into the position from which it was moved. This tendency will also depend, however, on the kind of ballast, being greater in coarse, angular ballast than in the finer materials, such as fine gravel, cinders, and so forth.

### Line Depends on Surface

By W. H. KING

Section Foreman, Missouri Pacific, Francitas, Tex.

Track that is newly surfaced is much easier to line than unsurfaced track, particularly if the latter has not been disturbed for some time. The reason for this is that the vibration from passing traffic causes the ballast in the cribs to settle and pack tightly against the ties. Track that has not been surfaced tends to hold the line better than newly surfaced track, however, because after the track is surfaced, it almost invariably settles out of surface and level here and there.

This settlement may be very slight, but every deviation from true surface

and level has its effect on the line. This tendency to get out of line at this time is increased by the fact that the ballast is still loose in the cribs and, therefore, offers minimum resistance to the movement of the ties. Any track that is not in perfect surface or that does not have sufficient ballast shoulder gets out of line, and the poorer the surface the more it will be out of line. For this reason, unless the low and out-of-level spots are picked up, the line will not hold, but will get progressively worse.

### Several Factors Involved

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

I think that any trackman will agree readily that it is easier to line newly surfaced track than track that has laid undisturbed on its old bed for a long time. An important reason for this conclusion is the fact that in track which has not been disturbed recently, the ballast in the cribs is generally packed rather solidly and offers considerable resistance to the movement of the ties. Again, the coarse particles in the ballast tend to bed themselves in the bottom of the tie and thus increase its resistance to movement in lining. Where the track has not been disturbed for some time, there is a tendency for the ties to become bedded at the center, and it is obvious that such track will be hard-

**Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.**

### To Be Answered in October

1. *How does one determine whether a tie will last for only one year? For two years?*
2. *How does one determine the proper length of piles for a pile trestle? For foundations?*
3. *What practical methods can be employed to maintain correct gage at railway crossings?*
4. *Should the report of the annual building inspection show all of the repairs that should be made, or only those that are imperative? Why?*
5. *Under what conditions are piles effective in stopping slides on embankments? Where should they be driven? Why? Should they be driven straight or on a batter? Why? If the latter, how much?*
6. *Is it essential to provide for ventilation at pumping plants where gasoline or oil engines are in service? If so, how should it be done?*
7. *Should rails be inspected for incipient breaks through the bolt holes before they are built up by welding? Why? If so, how should the examination be made?*
8. *What are the advantages and disadvantages of lubricating roller expansion bearings on steel bridges? What form of lubricant should be used?*

er to line than where the ties are not supported at the middle.

Because of the resistance to lining offered by the ties in well-bedded track, it is often necessary to loosen the ballast in the cribs before the track can be lined. In many cases also, the shoulder is so well compacted that it must be cleaned away from the ends of the ties. On the other hand, if the track is newly surfaced, the ballast in the cribs and on the shoulder will be loose, the ties will have little support at the center and the coarser and sharper particles will not yet be bedded in the wood, so that little resistance will be offered to the movement of the ties.

If the lining requires only a slight

movement  
a tendency  
to the in  
it is raise  
it is mov  
the line v  
on the co  
track is  
tremely  
less it is  
surfacing  
difficulty

W

Section F

While  
often ne  
surfacing  
done rec  
difficulty  
that has  
for some  
of surfa  
every e  
that the  
with po

Suc

What  
broken

Water F

Prob  
the bre  
streams  
is care  
this co  
the pun  
pumpin  
provisio  
much t

Theo  
through  
raised b  
At high  
Air lea  
retical  
practica  
pumps  
for cen  
At an  
practica  
ft. and

For  
be plac  
ply as  
imum  
low wa

movement of the rail, there may be a tendency for the ties to slip back into the inequalities of the bed, unless it is raised enough to prevent this. If it is moved more, the ability to hold the line will depend in large measure on the condition of the old bed. If the track is center bound, it will be extremely difficult to hold the line unless it is surfaced. If a proper job of surfacing is done, there should be no difficulty in holding the line.

## Would Surface First

By HENRY BECKER

Section Foreman, St. Louis-San Francisco,  
Rush Tower, Mo.

While in routine maintenance it is often necessary to line track without surfacing it, if no surfacing has been done recently, there is usually some difficulty in holding the line. Track that has not been raised off of its bed for some time is usually as badly out of surface as it is out of line, and every experienced trackman knows that the line cannot be held on track with poor surface, especially if the

defective condition includes uneven cross-level.

In speaking of surfacing and raising the ties off of the old bed, it is not intended to imply a general surfacing or a raise of one or more inches, although in many cases such a raise is necessary if both line and surface are to be maintained satisfactorily. Track that is down solidly on the old bed must be raised slightly in the lining operation in order to move it. This not only gives an uneven appearing surface, but permits some of the ballast in the cribs to run under the ties as they are moved, and this usually causes the track to settle out of line when the first train passes over it.

There is no question that newly surfaced track is easier to line than unsurfaced track, because the cribs and the ballast at the ends of the ties must be loosened to do the surfacing. Such track will hold its line better because the surface and cross-level have been corrected, while the ties have a better bearing after they have been eased off of the bearing under the center of the track.

might clog the passages of the pump, a strainer of liberal size should be placed on the end of the suction line. Where reciprocating pumps are used in connection with long suction lines, vacuum chambers should be placed next to the pump.

Where high suction lifts are unavoidable, it is necessary to keep the pump in good condition, particular attention being necessary to insure that the piston packing on reciprocating pumps fits properly and that the packing glands and seals are properly packed to avoid air leaks. When the water is low over the end of the suction line, reciprocating pumps may be operated at less than normal speed to avoid sucking air down into the end of the line.

Intake wells, properly designed, are valuable aids in periods of low water. Temporary dams and the ditching, piping or pumping by auxiliary pumps from pools located some distance up or down stream from the pumping station are expedients often resorted to in times of extreme drought.

## Suction Troubles at Low Water

*What action is necessary to prevent the suction being broken in small streams during periods of low water?*

### Limit Suction Lift

By J. H. DAVIDSON

Water Engineer, Missouri-Kansas-Texas,  
Parsons, Kan.

Probably the best insurance against the breaking of the suction in small streams during periods of low water is care to make proper provision for this condition in the installation of the pump and suction line when the pumping station is constructed. Such provision at this time will eliminate much trouble later.

Theoretically, the maximum height through which cold water can be raised by suction is 34 ft. at sea level. At higher altitudes this height is less. Air leaks and friction reduce the theoretical height, so that the maximum practical suction lift for reciprocating pumps at sea level is about 22 ft., and for centrifugal pumps, about 15 ft. At an altitude of one-half mile the practical lifts are approximately 20 ft. and 13 ft., respectively.

For these reasons, the pump should be placed as near the source of supply as practicable, so that the maximum suction lift during periods of low water will not exceed the practical

lift for the particular altitude of the pumping station. To overcome the difficulty encountered where centrifugal pumps are installed at points subject to wide variations in the water level, two suction lines are sometimes installed at different levels, the lower line being used when the stream is low and the higher one during high-water stages. This provides a wide suction range and, at the same time, prevents the power unit driving the pump from being overloaded when the stream is high.

It is important that the suction line be absolutely air tight; and as short, direct and free from bends as it is possible to make it. It should be laid without humps or depressions on a uniform grade, allowing about 6 in. of drop to 100 ft. of length from the pump to the source of supply. The suction line should always be as large as the suction flange on the pump, and if the line is more than 100 ft. long, or if the lift is high, the diameter should be larger than the suction flange of the pump.

With long suction lines or suction lifts of more than 15 ft., it is good practice to install a foot valve. If the water carries foreign matter which

## Two Causes for Breaks

By C. R. KNOWLES

Superintendent Water Service, Illinois  
Central, Chicago

There are two factors, either of which might cause the pump suction to be broken during low-water periods. The first is that the water level might recede to a point below the ability of the pump to make the lift. The second is the presence of air in the suction line. Theoretically, the maximum possible suction lift at sea level is 33.83 ft., while the actual practicable lift does not exceed 26 ft. This suction lift, both theoretical and practical, decreases with altitude. For example, a pump that can raise water 26 ft. at sea level, can raise it only 21.4 ft. if placed at an altitude of one mile. For this reason, to avoid interruption to the operation of the pump, the suction lift at sea level should not be greater than 26 ft., and preferably not more than 22 ft., for a displacement pump, and 15 ft. for a centrifugal pump.

A foot valve is always essential with a centrifugal pump, unless an auxiliary air ejector is provided for discharging air from the suction line. Foot valves are also desirable on displacement pumps, particularly if the suction lift is more than 15 ft. A suction pipe should always be air tight and the pump packing should be as nearly air tight as it is possible to make it, this being particularly important with suction lifts that are comparatively high.

At the intake end, the suction pipe should be at least 3 ft. below the surface of the water to prevent air from being drawn into the pump. This is of particular importance in small streams when the flow has decreased materially. In such cases, it is desirable to install an intake well which will make it possible to obtain the desired submergence at the end of the suction line at all times.

In shallow water, where horizontal suction lines enter the stream, it is sometimes possible to operate the pump without breaking the suction by placing a flat float constructed of planks, immediately over the end of the suction line. While this may be satisfactory as a temporary expedient, it is preferable to obtain the proper submergence of the suction intake if that is found to be possible.

of removing scale is with the sand blast. This method is not always available, however, and some other means of removing the scale must be employed. If the job is a small one, this can be done with a hand scraper and wire brush. Occasionally it will be necessary to use a chipping hammer on certain areas. I have known of cases where obstinate patches of scale have been loosened by applying kerosene and allowing it to remain on the surface for a few days.

If the job is of such size that purely hand methods are not warranted, a power-driven rotary wire brush will give good results. It may be necessary to supplement the work of this tool with the scraper, the chipping hammer and the hand brush where the scale is particularly obstinate or in close quarters where the rotary brush cannot be entered.

A surface that has been painted previously seldom needs complete cleaning unless it has been grossly neglected. For this reason, the cleaning is done in patches, where needed, the remainder of the surface being left untouched, the objective being only to remove rust and failed paint. The new steel surface must have its entire area cleaned to insure that the paint film will not be broken later by loosened scale which was overlooked when the cleaning was done.

## Cleaning New Steel Surfaces

*Why are new steel surfaces cleaned before painting?  
How should the cleaning be done to secure best results?  
In what ways do the methods differ from those employed  
on surfaces that have previously been painted?*

### Methods No Different

By E. C. NEVILLE

Bridge and Building Master, Canadian National, Toronto, Ont.

New steel surfaces always have mill scale attached to them and this must be removed before paint is applied. While there is less danger of the paint peeling off of a surface having mill scale than one which is covered with rust, the scale will loosen as a result of temperature changes, and if the paint breaks and peels, the surface so exposed will be left without protection against rust.

Mill scale can be removed with hand tools, such as scrapers and wire brushes, or with power-driven rotary brushes. Sandblasting is the best method of cleaning new steel surfaces, just as it has proved to be in cleaning corroded surfaces and those that have been cleaned and painted.

Where surfaces have been painted previously, it is necessary to clean only those areas that have rusted or upon which the old paint shows signs of failure. In contrast, the entire surface of the new steel must be cleaned carefully to insure that no particle of mill scale will be left on it.

### Must Remove Mill Scale

By MASTER PAINTER

When steel is rolled, a considerable amount of scale, very thin plates of metal which have cooled more rapidly than the underlying metal, cling to the surface. If this scale is not cleaned off, it will eventually loosen and fall off. If paint is applied to a surface from which the scale has not been cleaned, it will eventually fall off with the scale, leaving the metal

exposed. For this reason, a new steel surface should never be painted until all of the mill scale has been removed.

As a rule, structural members are cleaned of scale and given a priming coat in the shop during fabrication. Some times, however, for various reasons, the steel is not given a shop coat, in which event it may be necessary to remove the scale and do the painting in the field, either before or after erection.

Probably the most effective method

## New Tie Plates with New Rail?

*When laying rail having the same base as the old rail,  
should new tie plates be applied with the new rail?  
Under what conditions?*

### Always Lay New Plates

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

There is much food for thought in this question, since on one hand there may be considerable expense involved, while on the other, the life and maintenance of the new rail to the highest possible standard must be considered.

Not many years ago we were renewing rail long before it was worn out, largely because of the condition of the ends, primarily as a result of chipping and batter. Today, by reason of the development of methods for reconditioning the ends and for compensating for wear on the fishing surfaces, rail has a much longer life than formerly and is seldom renewed until a very considerable amount of wear has taken place.

By the time the rail itself is worn to this extent, it is certain that the tie plates will be correspondingly worn and that corrosion will have caused an appreciable reduction in section, particularly on roads handling a heavy refrigerator traffic. Again, uneven wear of the ties and the difference in the resistance of different woods to plate cutting have a marked effect in causing uneven wear on the rail-bearing surface of the plates.

For these reasons, if the old plates are reused with new rail, it may be that uneven wear will occur on this rail, and uneven wear makes it difficult to maintain either good surface or good line, besides spoiling the appearance of the rail. It is not unusual today for a road to increase the size of its tie plates, even when laying rail of the same section as that released, because the old plates do not have sufficient area to give maximum protection to the ties. In this case it is

obvious with the percenta sary to released tracks should b be used laid, th material.

For t that, wi good po with ne rail mus age lon other in id that there is plates. worn o be expe greater they sho the new

Chief En tral Reg

As a new tie new rail sons wh excepti the com such th location the ne should serve v are oth visible One re ing is r ties fo new p This o mechan

Wou

Section

If t as the reason the ol On th stance too sr protec that t the ra Aga

obvious that new plates will be used with the new rail. Except for a small percentage which it is generally necessary to class as scrap, all of the rail released from important main-line tracks will be used in secondary tracks. As the ties in these tracks should be protected, the old plates can be used when the released rail is relaid, thus avoiding any waste of material.

For the reasons given, I believe that, with a single exception, it is good policy to apply new tie plates with new rail. Cases occur where rail must be renewed because of damage long before it is worn out. In other instances, curve wear is so rapid that renewal is necessary before there is appreciable wear on the tie plates. Where the tie plates are not worn or so little worn that they may be expected to have a life equal to or greater than that of the new rail, they should be continued in use when the new rail is laid.

### Yes, Generally

By J. B. BAKER

Chief Engineer Maintenance of Way, Central Region, Pennsylvania, Pittsburgh, Pa.

As a general principle I believe that new tie plates should be applied with new rail, but there are numerous reasons why it is entirely proper to make exceptions to this general policy. If the condition of the old tie plates is such that their service life in a given location will exceed the service life of the new rail in that location, they should be left in place and allowed to serve with the new rail, unless there are other reasons which make it advisable or necessary to remove them. One reason might be that heavy adzing is required properly to prepare the ties for the new rail, in which case new plates should be substituted. This occurs more particularly where mechanical adzers are used.

### Would Use Some Old Plates

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

If the new rail has the same base as the rail to be released, I see no reason for using new plates, provided the old ones are in good condition. On the other hand, in not a few instances, the old plates may have been too small in area to give adequate protection to the ties, or too thin, so that they have become bent under the rail.

Again, if they have been in service

a long time, they may be so badly corroded or worn that they are unfit for further use. In any of these cases, new tie plates of greater area or heavier section, or both, should be applied with the new rail.

If the old tie plates have any of the defects mentioned, one can expect the new rail to be damaged if the old plates are continued in use. No one can get an even bearing for the rail on such plates, and rail that is

laid without an even bearing is sure to become surface bent and to wear unevenly, with a resulting adverse effect on the riding qualities of the track. In addition, they definitely increase the difficulties and cost of maintenance. One can easily throw away money by discarding good tie plates, but an equal, or perhaps greater, waste can be created by relying on old tie plates that are badly worn or otherwise defective.

## Proper Length of Track Wrenches

*Is there a definite relation between the diameter of track bolts and the proper length of the wrench? Why? If so, what is this relation?*

### The Limit is 48 In.

By C. R. SCHOENFIELD

Roadmaster, Chicago, Burlington & Quincy, Aurora, Ill.

Our standard wrenches, which range in length from 30 in. for  $\frac{3}{4}$ -in. bolts to 48 in. for bolts between 1 in. and  $1\frac{1}{2}$  in., inclusive, and which we have been using for some time have proved to us to be very satisfactory tools.

I can see no reason why a track wrench needs to be longer than 48 in. except the special wrenches that must be used around railway crossings, where the bolts are larger in diameter and longer, and where much stiffer spring washers are used. For such use it may be desirable to provide a special wrench which retains the proportions found in the A.R.E.A. design for standard track wrenches.

Equally as important as length is the finishing of wrenches, which should be given careful consideration. A tool that is well finished and properly balanced, will be valued more highly by the man using it than one having either poor finish or balance. He will take much better care of such a tool, while because of its superiority it will be a safer tool.

The jaws of wrenches should be true and exactly the size specified. If the dimensions of the nut are correct, there will then be a negligible amount of play between the wrench and the nut, the wrench will last much longer and it will not pull over the corners of the nut and round them. No attempt should ever be made by trackmen to make a wrench fit the nuts. If the wrench fits too tightly or is too loose, the tool should be laid aside and the roadmaster notified so that steps can be taken to discover the source of the discrepancy.

A wrench that can be made to fit an undersized or an oversized nut by pounding it on the rail with a spike maul to close or spread the jaws, is made of material that is too soft to last long. If it is properly tempered, any such attempt to adjust the width of the jaws will usually result in cracking them.

### There Are No Standards

By DIVISION ENGINEER

It has been our practice to use our shorter wrenches for small-diameter bolts and the longer ones for the large bolts, with intermediate lengths for the intermediate sizes of bolts. In studying these lengths in the light of the question, I fail to find that our designs bear any definite relation to the bolts, other than the general one that there is an increase in length as the bolt diameter increases. In fact, we have two lengths for some identical sizes of bolts.

Upon rereading the article on track wrenches in the January issue of *Railway Engineering and Maintenance*, I was more impressed this time than in the first reading by the fact that engineers apparently have made no attempt to determine whether any definite relation really does exist between the diameter of the bolt and the proper length of the wrench. If they had done so, I feel quite certain that designs would not call for lengths ranging from 30 in. to 54 in. for bolts of the same diameter. Incidentally, I do not believe that any design would call for 54-in. track wrenches if this had been done.

I can easily see the basis for the assumption, which I believe to be at least approximately correct, that the length of the wrench should increase as the bolt diameter increases. I am

not of the opinion, however, that the change in length of the wrench should exactly parallel the changes in bolt diameters.

It would be ridiculous to maintain that the length of the wrench should increase exactly as the diameter of the bolt increases. Since this diameter increases by increments of 1/16 in., a separate length of wrench for each diameter of bolt would require too many wrenches. There is a practical side to the matter, and I believe that not more than four lengths, say, from 30 in. to 48 in., would be sufficient to fulfill all requirements.

One difficulty that I have experienced is that many trackmen are reluctant to use the shorter wrenches because they have to bend over too much when tightening bolts. For this reason, they extend the wrench by slipping a piece of pipe over the end, thus enabling them to stand upright when wrenching. In many cases, this is not done with the idea of securing greater tension in the bolt, but purely for personal convenience. As a matter of fact, however, the longer lever arm thus obtained often results in overstressing the bolts and thus in troublesome frozen joints.

### No Relation Exists

By DISTRICT ENGINEER

The special committee of the American Railway Engineering Association, which is studying stresses in track, has determined that certain bolt tensions (not unit stresses), ranging from 5,000 lb. to 20,000 lb., will give best results with respect to supporting the rail ends, depending on the type of joint in use. Assume for the moment that it is desired to maintain a bolt tension of 15,000 lb. It will be noted that the magnitude of this tension bears no relation to the diameter of the bolts, since this is the tension that is to be maintained in the bolts in all joints, regardless of the weight or section of the rail and, therefore, of the diameter of the bolts.

Remembering that we are not dealing with unit stresses but with absolute tension, the length of the wrench should be that which will enable the trackman to obtain this tension without undue exertion. It is evident, therefore, that the proper length of the wrench bears no relation to the size of the bolt, but is related only to the tension that is desired. In other words, a 15,000-lb. tension can be obtained with a single length of wrench as easily in a 1 1/8-in. bolt as in a 1-in. or a 7/8-in. bolt.

On the other hand, a definite rela-

tion does exist between the bolt tension and the length of the wrench. It is obvious that a wrench of the proper length to obtain a tension of 5,000 lb. would be too short if 20,000 lb. is desired, while a length suitable for the higher tension would be too long to use with safety where the lower tension is to be maintained. It is difficult to control the tension if the use of long wrenches is permitted.

I think that the whole question of bolts and wrenches needs to be studied rather intensively in the light of the data which have been gathered by the Committee on Stresses in Track. Certainly, if a definite bolt tension is desirable, it does not require four or five diameters of bolts to obtain this tension. In this connection, the A. R.E.A. designs for joint fastenings call for a 1-in. bolt for both the 112

and the 131-lb. rail sections. If a 1-in. bolt is adequate to maintain a tension of 20,000 lb., the maximum suggested by the committee, bolts of larger diameter would seem to be unnecessary.

On the practical side, the larger-diameter bolts may be too large for the smaller rail sections, and there are other factors than the stress developed in tightening the bolts, which make the smaller diameter unsuited for the larger rail sections. Yet there seems to be little reason why fewer sizes of bolts will not give as satisfactory results as the large number now in use. Likewise, if the problem of wrenches is approached from the view point of bolt tension rather than of bolt dimension, I believe that a new conception of the design and use of this tool will be developed.

## Filling Over Concrete Arches

*Where a concrete arch or box culvert replaces a steel span or timber trestle, what method should preferably be followed in filling over the structure? Why?*

### Two Distinct Operations

By M. HIRSCHTHAL

Concrete Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

Where a concrete culvert of either the arch or box type is installed under a track, or tracks, to replace a trestle or open span, at a depth where filling material is required, the procedure to be followed falls naturally into two distinct operations. The first is the installation of the culvert and the other is the placing of the fill to subgrade. Superficially, it would appear that after the culvert has been completed, all that would be necessary would be to dump enough material over it to bring the embankment to the required height and width, then remove the old structure, or the temporary trestle if this has been used, and resume normal traffic. This is far from being true.

There is positive danger of failure if the filling material is deposited over the structure in such a way as to create conditions contrary to the assumptions of loading under which the culvert was designed. Culverts are invariably designed for equal pressure from the fill on each side. It is essential, therefore, that the fill shall be deposited on both sides of the culvert in layers as nearly uniform as practicable until the top of the structure is reached. The fill above the level of the top of the structure should be

placed simultaneously on each side, so far as this is practicable, not permitting any sizeable difference at any time between the height of the fill on the two sides of the culvert.

If the work is not done in this way, the danger of failure is in direct proportion to the height of the fill above the top of the culvert, as this surcharge is more effective in exerting a thrust against the culvert than that part of the fill along the opposite wall of the culvert, with the result that there is created not only an unbalanced horizontal thrust against the culvert, but the resultant of this thrust and the vertical load causes an eccentric pressure on the culvert foundations. This greatly increases the soil pressure under the opposite edge or corner, possibly exceeding the safe bearing power of the soil. This, in turn, may result in yielding or settlement of the corner, with a tendency both to overturn and to slide.

These are not fanciful or theoretical ideas. They are not only likely to occur but have actually occurred on more than one project. The writer had an opportunity to observe just such a faulty program of filling in a location where soil conditions tended to make the progressive filling from one side a dangerous procedure. The results were unfortunate and were identical with the picture which has been outlined.

For these reasons, it is of the utmost importance to insure that the

filling material on both sides of the culvert, so that the height of the fill is kept as nearly equal as possible, progressing from the lower part of the culvert to the level of the top of the structure.

Another factor to be considered in the selection of the method for the embankment, especially where the culvert is designed for heavy loads, is the use of light or heavy locomotive wheels. In the execution of the work, it is essential that the method employed for the filling be such that the loaded and unloaded wheels of the locomotive are certainly be-

Met.

Supervisor B. J. B. of Missouri Pacific.

In the filling of a culvert, whether it be a trestle or a box culvert, the method of placing the fill over the hardened structure is of approximate importance. When the culvert is filled, the experience will be obtained by bringing up the fill to a width of the culvert, and to above the top of the culvert. If the grade is more than a few feet above the top of the culvert, the width of the fill should be proportionate to the height of the fill. This is an important consideration, especially if the culvert is unloaded, the impact of this considerable load may cause damage to the culvert, especially if it is not protected.

Where the progress of the filling of the culvert is not uniform, the possibility of failure (that is, partial collapse of the structure) of the embankment, especially where the culvert is unloaded, is a serious consideration. This may be prevented by preserving the height of the fill under very high loads, where all of the weight of the lower part of the culvert and scrapers is

filling material will be deposited on both sides of the culvert in such a way that the height on each side will be kept as nearly equal as practicable, progressing in this manner clear up to the elevation of the subgrade.

Another note of warning which should not be ignored concerns the selection of the material to be used for the embankment. At times, especially where large culverts are being designed for use under high fills, the loads are, for economy, based on the use of light-weight materials, such as locomotive cinders or granulated slag. In the execution of the project, it is essential that the assumed material, or other material of like weight, be employed for making the fill. Otherwise, the foundations will be overloaded and the structure itself will certainly be overstressed.

### Method Important

By L. G. BYRD

Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

In the first place, a concrete culvert, whether it be an arch or a rectangular box, should not have filling placed over it until the concrete has hardened sufficiently to develop approximately its designed strength. When the culvert is ready, it has been my experience that the best results will be obtained if the filling is brought up uniformly on both sides to a width of at least 10 ft. on the sides, and to a height of 4 to 6 ft. above the top, in well compacted layers. If the elevation of the subgrade is more than 12 ft. above the top, the width and height of the tamped material should be increased proportionately. This is particularly important on high fills that are made with train haul, in which the material is unloaded from dump cars. The impact of this material falling from a considerable height may cause serious damage to the structure unless it is protected by an adequate cushion, especially if large boulders are present.

Where practicable, the filling should progress uniformly from end to end of the culvert. This will avoid the possibility of longitudinal movement (that is, parallel to the axis of the structure) of the material in the embankment, either as the filling progresses or later as settlement occurs. This may be an important factor in preserving the stability of structures under very high fills. There should be no difficulty in accomplishing this where all of the embankment, or even the lower part of it is made with teams and scrapers from nearby borrow pits.

If the entire fill is placed by train, the added expense of building up in horizontal layers that part of the fill over the culvert is money well spent.

In any event, the closest supervision should be exercised to insure that the height of the fill on one side of the structure shall be kept approximately equal to that on the other side. If unequal filling is permitted, an unbalanced load is placed transversely of the structure and there is danger that some part of it may tend to tip over or slide out of position. Obviously, such a condition may cause partial or complete failure of the section so affected.

Another precaution which we have found to be desirable in the case of

high fills is that material dumped from the track level should not be allowed to run against flared wing walls. Compacting the material behind them to their full height is desirable, in addition to which it is well to apply braces against the exposed faces until the filling is completed. A good way to do this is to erect the braces between the wings.

During recent years we have been installing culverts and filling openings ranging up to 120 ft. in depth. In all of these projects we have felt that we were warranted in observing the precautions which have been outlined, with the result that in the large number of projects completed we have found no indication of failure.

## Pipe Coils or Cast-Iron Radiators?

*Are pipe coils or cast-iron radiators more effective for heating engine-houses and shops? Why?*

### Cast Iron More Efficient

By W. L. CURTISS

Mechanical Engineer, New York Central, New York

Cast-iron radiators are more efficient than pipe coils from the standpoint of heat transference, for the reason that they induce a more rapid circulation of air and provide more intimate contact of the air with the heated metal. However, on the New York Central, where we do not have a hot-air heating system in an engine-house, pipe coils are used in preference to cast-iron radiators. The reason for this is that they occupy less space, they can be more readily installed along the back wall of the engine-house, and the cast-iron radiators are more easily broken by coming in contact with heavy parts which must be handled in enginehouses.

### Pipe Coils Economical

By A. T. HAWK

Engineer of Bridges, Chicago, Rock Island & Pacific, Chicago

In general, it is more economical to use direct radiation, that is, pipe coils or cast-iron radiators, only in the smaller enginehouses and shops. This statement takes into consideration the first cost and maintenance as well as the actual cost of heating by either steam or hot water. Pipe-coil radiators can generally be installed at less cost and maintained more easily than cast-iron radiators, since they can be made up from material that is

readily available, because the pipe and fittings necessary to do this are standard items of storehouse stock. They will stand far more abuse and can be used with higher steam pressures than cast-iron radiators. In many cases space is important and pipe coils can be made up to fit into limited space of almost any shape and size. They can be supported more easily or hung on the wall, and it is easier to provide for expansion with this type of radiation.

Cast-iron radiators can be built up into units having more square feet of radiating surface for a given area of wall surface than pipe coils. They are not so easily supported, however, and greater care must be exercised in providing for expansion. Owing to the thinner walls of the cast sections, they transfer heat more rapidly than an equal surface area of the pipe coils. Furthermore, since the radiating surface is concentrated in a smaller wall area than in the case of pipe coils, they allow better circulation and better drainage of the condensation.

To secure best results, the vacuum-return system should be used with either the pipe coils or the cast-iron radiators. In enginehouses the radiators should be placed on the side walls of the engine pits and properly protected against injury from falling parts. Above the floor line they should be placed on the outer wall between pits and against fire and end walls. It is not good practice to place radiators directly in line with the engine pits, because locomotives sometimes overrun the pits and crash into the outer wall.

In the larger and more important enginehouses and shops it is more commonly the practice to use a system of indirect heating in which hot air is driven by fans through permanent ducts, under the floors where this is practicable. Where this system is used, the outlets should, generally, be placed in the engine pits, and fitted with dampers so that the heat can be shut off in certain sections of the building when desired.

Unit heaters are coming into use for heating both shops and enginehouses. The first cost for this method is relatively low; the heaters can be hung free of the floor, thus avoiding the sacrifice of floor space; they can

be maintained easily and cheaply; and, if properly located, can be depended on to give even heat throughout the building with economy of operation.

Unit heaters are operated by electric fans that are easily controlled, that is, they can be started or stopped at will, and in this way a predetermined temperature can be maintained. The heating coils in the units operate whether the fan is running or has been stopped. For this reason, the building can be heated in mild weather with no consumption of electrical power. All piping, including the mains and return lines, is overhead where it can be maintained economically and without difficulty.

## The Throw of a Switch Stand

*How does one adjust the throw of a switch stand?  
What precautions should be observed?*

### Adjustment Is Simple

By W. H. KING

Section Foreman, Missouri Pacific,  
Francitas, Tex.

Adjust the No. 1 and No. 2 head rods so that the points will stand  $4\frac{3}{4}$  in. from their respective stock rails as the switch is opened and closed. When the switch has been thrown, attach the connecting rod to the switch stand and the head rod and adjust the position of the stand on the head blocks until the points fit when the switch is thrown for either side. When this has been accomplished, fasten the stand permanently to the head blocks.

Precautions to be observed are (1) see that the stand is fastened securely by spikes or bolts to the head blocks; (2) see that all bolts are tight and protected with cotter keys; (3) be careful that the target and lamp line up with the main line when the points are thrown either way.

### Several Operations

By A. H. PETERSON

Roadmaster, Chicago, Milwaukee, St.  
Paul & Pacific, Chicago

First, we must know what the throw of a switch is. It is the distance on the open side of the switch point from the gage side of the nearest stock rail to the stock-rail side of the switch point, measured midway of the transit clip to which the No. 1 or head rod is attached. The A.R. E.A. standard for this is  $4\frac{3}{4}$  in.

Each transit clip has four bolt holes, staggered to permit the rods to be moved to make adjustments necessary as the switch wears. Before setting up the stand, all rods are attached to the points and bolted to the transit clips through the rear holes in the latter. The throw will then be  $4\frac{3}{4}$  in., if the installation has been made properly.

Next the stand should be set up on the head blocks, and the connecting rod attached to the stand and the No. 1 rod. The stand should then be squared up so that the target lines properly for the through route. Using a bar, the switch point may now be thrown over for the main track, or through, movement. The handle of the switch stand should be opened and turned about 2 in. to take out the slack, after which the stand may be tacked to the head blocks by two partly driven spikes.

At this point the operating lever is thrown clear over to make certain that both points close properly. If they do, the stand should be fastened permanently to the head blocks by means of  $\frac{3}{4}$ -in. bolts, with the nut end up. If the bolt holes in the head blocks are prebored, less labor will be required, although some respacing of the ties may be necessary.

To set up a parallel-throw ground stand, the same connection is made as for the high stand. To adjust the throw of the points, open them, dividing the throw so that each stands  $2\frac{3}{8}$  in. from its parent stock rail. Raise the handle till it stands vertical and spike the stand to the head blocks. When the handle is lowered, either right or left, to the horizontal

position, the points will fit tight in the proper position.

When setting up switch stands of any type the track must be to exact gage. On main-line switches gage plates are in general use, and these automatically establish correct gage. On old switches, in yards and elsewhere, where gage plates are not available the gage must be brought to exact standard. It is especially objectionable to take up lost motion in the rods, caused by wear, by inserting nut locks or washers between the transit clips and the points. It is equally objectionable to drive a spike in the jaw of the head rod where it unites with the transit clip. Either action will decrease the throw of the points by the thickness of the object inserted, rendering it possible for a wheel flange to strike the point. Spikes so inserted may jar out, leaving an objectionable lip on the closed-point side.

Care must be exercised to insure that the head blocks are square across the track. If they are not, the throw will be increased on one side and decreased on the other. The switch points should also be checked to insure that one is not ahead of the other, or the head rod will be at an angle across the track, causing the throw on one side to be wrong. The head blocks should be spaced properly, 22 in. being the usual spacing, measured from the center of the gage plate on the forward head block to the center of the second head block.

Switch rods and connecting rods should be tightened firmly. All bolts should have cotter keys. The connecting-rod bolt must always be placed with the nut up and the cotter key in view. Worn holes in old rods may be reamed and a larger bolt used.

Where practicable the switch stand should be on the closed-point side of the main track. It is also good practice to adjust the stand so that when the operating lever is in the closed position for main-line movement it will be toward the main track. This makes it easy to observe it from passing trains and motor cars. Furthermore, a man operating the switch must swing his body away from the track, thus reducing the probability of being struck by cars or of falling across the rail in case his hand slips from the handle.

Readjustment of the points can be made quickly with the transit clips by moving the No. 1 rod forward to the next hole in the transit clip. If the switch has multiple rods the same adjustment can be made in the remaining rods, although adjustment of the No. 1 and No. 2 rods is usually sufficient.

### K.C.S. For Unique S

Twenty-si  
service fore  
ing foreman  
have worke  
single repor  
among them  
diction, acc  
second-quar  
Southern en  
end of the  
group who c  
curring any  
privileged to  
for 10 year  
safety recor  
hold one-yea

### Carloading to Increase

Freight c  
States in th  
Expected to  
the actual lo  
period of las  
compiled by  
Advisory Bo  
estimates, lo  
commodities  
000 cars in th  
with actual l  
the same com  
of 1934. Ni  
that carloadi  
gions in the  
last year, wh  
carloadings

### Rail Net f About Sar

For May t  
United States  
income of \$3  
annual rate  
their property  
with a net of  
the same re  
month of 193  
May amount  
pared with \$  
decrease of 0  
penses in M  
against \$210,0  
year ago, a d  
For the fir  
these roads h  
income of \$1  
per cent on th  
basis, as com  
2.12 per cent  
year. Operat  
months totale

# News of the Month...



## K.C.S. Foremen Have Unique Safety Record

Twenty-six track foremen, two water-service foremen and a bridge and building foreman on the Kansas City Southern have worked for nine years without a single reportable injury having occurred among them or the men under their jurisdiction, according to an article in the second-quarter issue of the Kansas City Southern employees magazine. At the end of the year those foremen of this group who complete the year without incurring any reportable injuries will be privileged to carry a card indicating that for 10 years they have had a perfect safety record. All these foremen already hold one-year and five-year cards.

## Carloadings Expected to Increase Slightly

Freight carloadings in the United States in the third quarter of 1935 are expected to be about 2.9 per cent above the actual loadings in the corresponding period of last year, according to estimates compiled by the 13 Shippers' Regional Advisory Boards. On the basis of these estimates, loadings of the 29 principal commodities are expected to total 4,954,000 cars in the third quarter, as compared with actual loadings of 4,812,279 cars for the same commodities in the same period of 1934. Nine of the boards anticipate that carloadings in their respective regions in the third quarter will rise above last year, while in the other four regions carloadings are expected to be lower.

## Rail Net for May About Same as Last Year

For May the Class I railroads of the United States had a net railway operating income of \$39,505,068, which was at the annual rate of return of 2 per cent on their property investment, as compared with a net of \$39,699,195, or substantially the same return, in the corresponding month of 1934. Operating revenues for May amounted to \$279,549,320, as compared with \$282,039,312 in May, 1934, a decrease of 0.9 per cent. Operating expenses in May totaled \$209,195,937 as against \$210,028,161 in the same month a year ago, a decrease of 0.4 per cent.

For the first five months of the year these roads had a net railway operating income of \$160,787,970, a return of 1.85 per cent on their investment on an annual basis, as compared with \$184,829,269, or 2.12 per cent, in the same period of last year. Operating revenues for the five months totaled \$1,354,258,406, as against

\$1,347,117,608 for the same period in 1934, an increase of 0.5 per cent. Operating expenses amounted to \$1,042,998,567, as compared with \$1,003,973,812, an increase of 3.9 per cent.

## Railway Employment Shows Increase in June

As of the middle of June the Class I railroads of the United States had 1,014,848 employees on their payrolls, an increase of 17,803, or 1.8 per cent, as compared with May, and the highest for any month since October, 1934, according to preliminary reports made to the Interstate Commerce Commission. Moreover, the index of railway employment, which is based on the 1923-25 average, amounted to 56.8 per cent in June, the highest for any month since September, 1934. However, employment in June showed a decrease of 3.75 per cent, as compared with the corresponding month of 1934. The best showing in June was made by the maintenance of way group. The number of employees in this group as of the middle of the month totaled 229,414, an increase of 7.56 per cent as compared with May. The next best increase (1.05 per cent) was made by employees in the transportation group.

## Notes on High-Speed Trains

The high-speed trains that have been placed in service by various western railroads are continuing to show encouraging results in the number of passengers carried. The "400" of the Chicago & North Western, which was placed in service between Chicago and the Twin Cities on January 2, 1935, has carried an average of 150 passengers a day each way since it has been in service. Since June 2, when the Twin Zephyrs of the Chicago, Burlington & Quincy were each placed on a daily round-trip schedule between the same two points, each train, with a capacity of 88 passengers, has averaged 78 passengers per trip.

The Hiawatha, which was placed in service between these cities on May 29 by the Chicago, Milwaukee, St. Paul & Pacific, has averaged 276 passengers per trip. The highest number was reached on June 29, when 500 revenue passengers were carried on the northbound train and 408 on the southbound train. On the streamliner "City of Portland," which has been operating over the North Western and the Union Pacific between Chicago and Portland, Ore., since June 6, sleeping accommodations have been sold out completely on each trip and, since the adoption of a plan for making coach seat reservations to insure accommodations

for that class of travel, the coaches have likewise been filled to capacity. Since June 2, when a schedule of 5½ hr. was established between Chicago and St. Louis, Mo., patronage of the trains meeting this schedule on the Wabash, the Chicago & Eastern Illinois and the Illinois Central has increased substantially. Since the Alton placed its "Abraham Lincoln" in service on July 1, its passenger business between these cities has increased 25 per cent.

## New Equipment on Order and Installed

The Class I railroads of the United States in the first five months of 1935 installed 1,294 new freight cars in service, as compared with 2,327 new freight cars in the comparable period of last year and 1,249 in the first five months of 1933. Twenty new steam locomotives and 55 new electric locomotives were placed in service during the first five months as compared with one new steam locomotive and six new electric locomotives in the corresponding period of last year.

New freight cars on order on June 1 totaled 1,479 as against 20,011 on the same day in 1934, and 1,205 on the same day in 1933. On June 1, the railroads had on order 10 new steam locomotives and 37 new electric locomotives.

## Rules Issued for Grade Separation Program

Complete rules and regulations for governing the use of the \$200,000,000 federal railway-highway grade crossing elimination and protection program, which were prepared by the U.S. Bureau of Public Roads under the Secretary of Agriculture, were approved by the President on July 12. The \$200,000,000 allotment for this work has been made from the \$4,000,000,000 Emergency Relief Appropriation that is to be devoted to the relief of unemployment. The rules provide that the allotment for grade crossing work is to be available to pay the entire cost of projects including the separation of grades at crossings, the protection of grade crossings (by signals, crossing gates, etc.), the reconstruction or improvement of existing grade separation structures, and the elimination of highways to eliminate grade crossings. It is provided that the money shall be apportioned to the individual railroads within any state on the basis of the total mileage of railways within the state. In order to create the maximum number of jobs it is stipulated in the rules and regulations that (1) the cost of each project shall be such as to provide the equivalent of a man-year of employment at a total cost to the federal government, including labor and materials, of not exceeding \$1,400 or that (2) that 40 per cent of the total cost of the project must be paid to persons employed directly on the project. However, since these high percentage labor stipulations may prove impracticable on many projects, provision is made for the use of an alternate plan which requires the use of state funds in addition to the federal funds in providing the stipulated number of jobs.

## Association News

### American Railway Bridge and Building Association

Preparations for the forty-second annual convention, which will be held in the Hotel Stevens, at Chicago, on October 15 to 17, inclusive, are rapidly assuming final form, and the arrangements for the program are nearing completion. Four reports are already in the hands of the secretary, and the others are about completed.

The Bridge and Building Supply Men's Association is completing arrangements for an exhibit of bridge and building materials, equipment and supplies in connection with the convention. In view of the larger space available this year for such an exhibit, it is expected that it will be the largest and most complete in the history of the two associations.

### American Railway Engineering Association

Most of the copy for the summer bulletins is now in the hands of the printer and it is expected that the first one will be issued shortly with the remainder to follow at close intervals. Among the important papers to be included in these publications is the progress report of the joint investigation of fissures in rails, which was presented verbally by Dr. H. F. Moore at the March convention, as part of the report of the Rail committee.

A monograph by Dr. George E. Ladd, consulting engineer-geologist, entitled Landslides, Subsidence and Rock Falls, will also be published as an appendix to the report of the Committee on Roadway.

At the time the Committee on Iron and Steel Structures presented its new specifications for steel bridges at the March convention, it promised to make available the supporting data upon which the provisions for impact were based. These will appear in one of the summer bulletins in the form of a monograph by J. B. Hunley, engineer of bridges, Cleveland, Cincinnati, Chicago & St. Louis, who conducted an extended investigation of impact on bridges on his road.

Another paper of importance will be a monograph by the late C. F. Loweth, formerly chief engineer of the Chicago, Milwaukee, St. Paul & Pacific, on Economic Considerations Involved in the Construction and Use of Inland Waterways of the United States.

Eight committees held meetings during July as follows: Yards and Terminals, at Toronto, Ont., on July 8; Maintenance of Way Work Equipment, at Chicago, on July 9, with 16 members and 4 guests present; Iron and Steel Structures, at Cleveland, Ohio, on July 11 and 12, with 17 members present; Economics of Railway Operation, at Erie, Pa., on July 18 and 19; Highways, at Chicago, on July 23; Water Service, Fire Protection and Sanitation, at Chicago, on July 23; and Records and Accounts, at New York on July 25 and 26.

## Personal Mention

### General

**William J. Harahan**, senior vice-president of the Chesapeake & Ohio and the Pere Marquette, and formerly chief engineer of the Illinois Central, has been elected president of the C. & O. and the P. M., with offices at Richmond, Va., and Cleveland, Ohio. He succeeds **John J. Bernet**, who died on July 5. Mr. Harahan was born on December 22, 1867, at Nashville, Tenn., and first entered railway service in 1881 as a messenger and clerk in the superintendent's office of the Louisville & Nashville at New Orleans, La.



William J. Harahan

After spending two years in the shops of this company as an apprentice, Mr. Harahan was transferred to the engineering department in 1886. In 1889, he went with the Chesapeake & Ohio as engineer maintenance of way of the Cincinnati division and in the following year he was placed in charge of structures on the Baltimore & Ohio Southwestern. In 1892, he entered the service of the Illinois Central as roadmaster and trainmaster on the Pontiac division, being advanced to assistant superintendent of the Freeport division in April, 1895, and to superintendent in October of the same year. Six years later Mr. Harahan was appointed chief engineer of the Illinois Central and following a little more than a year in this position he was appointed assistant general manager. In 1905, he was given the title of fourth vice-president and general manager and two years later he was made vice-president in charge of traffic and engineering. In July of the same year, Mr. Harahan left the Illinois Central to become assistant to the president of the Erie. Four years later he was elected vice-president in charge of engineering of that railroad, which position he held until September 26, 1912, when he was chosen president of the Seaboard Air Line. After serving as federal manager of this line during government control of railroads, he was made a member of the Railway Board of Adjustment No. 1,

Division of Labor, United States Railroad Administration, which position he held until December, 1920, when he was made president of the Chesapeake & Ohio. Since 1929, Mr. Harahan has served as senior vice-president of the C. & O. and the P. M.

**Joseph F. Davis**, acting superintendent of the Arkansas division of the Missouri Pacific and formerly district engineer on this road, has been appointed superintendent of the same division, with headquarters at Little Rock, Ark. Mr. Davis was born on April 25, 1878, at Brinkley, Ark. He entered railway service in 1897 as a maintenance worker on the St. Louis Southwestern (Cotton Belt), serving as a trackman, track foreman, extragang foreman and brakeman until 1903. In that year Mr. Davis entered the service of the Missouri Pacific as an extragang foreman, with headquarters at Little Rock, serving in that capacity until 1906, when he was advanced to roadmaster. Following thirteen years service as a roadmaster he was promoted to general roadmaster, with headquarters at McGehee, Ark. From 1920 to June 1, 1926, Mr. Davis served as division engineer at Little Rock and on June 1, 1926, he was promoted to assistant superintendent, which position he held until August 1, 1928, when he was appointed superintendent of the Omaha division, with headquarters at Falls City, Neb. In May, 1933, Mr. Davis was appointed district engineer at Little Rock and in June, 1934, he was made acting superintendent.

### Engineering

**Felipe J. Sanchez** has been appointed chief engineer of the National Railways of Mexico, with headquarters at Mexico, D.F., to succeed **Salvador M. Arcocha**.

**H. G. Watkins** has been appointed engineer maintenance of way of the Akron, Canton & Youngstown, with headquarters at Akron, Ohio.

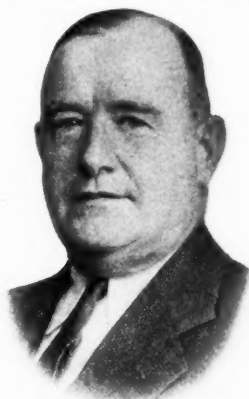
**F. J. Ackerman**, engineer maintenance and signals of the Kansas City Terminal, Kansas City, Mo., has been appointed chief engineer, succeeding **J. V. Hanna**, whose death was noted in the June issue.

**R. H. Carter**, supervisor of track on the Illinois Central with headquarters at Chicago, has been appointed acting division engineer, with the same headquarters, to relieve **J. J. Desmond**, who has been granted a leave of absence because of ill health.

**W. O. Dennis**, inspector maintenance of way on the Lehigh & New England, with headquarters at Bethlehem, Pa., has been appointed engineer maintenance of way, with the same headquarters, succeeding **F. W. Gilcreast**, who has been appointed consulting engineer, with headquarters at Bethlehem. The position of inspector maintenance of way has been abolished.

Mr. Dennis was born on December 31, 1882, at Nazareth, Pa., and was educated at Nazareth Hall Military Academy and Lafayette College, Easton, Pa. After being employed in the engineering department of the Lehigh & New England dur-

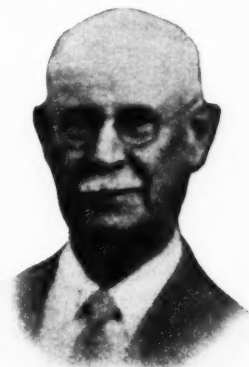
ing his summer vacations while in college, Mr. Dennis entered active railroad service as a transitman on the L. & N.E. during the summer of 1905, since which date he has continued in the service of this road. He was advanced through various positions in the engineering department to that of assistant engineer, which position he held until March, 1913, when he was promoted to assistant super-



W. O. Dennis

visor, with headquarters at Pen Argyl, Pa. In April, 1917, Mr. Dennis was advanced to the position of supervisor, with the same headquarters. In February, 1924, he was promoted to inspector maintenance of way.

Mr. Gilcreast was born on April 2, 1858, in Massachusetts, and completed his scholastic education at Tufts College. While in college Mr. Gilcreast worked as a chainman on the Boston & Lowell (now Boston & Maine) during his summer vacations. He entered active railroad service as a rodman on the New York & New England (now New York,



F. W. Gilcreast

New Haven & Hartford) in 1880. In 1881 he became a levelman and resident engineer on location and construction on the New York, Chicago & St. Louis (Nickel Plate) and in 1882 became resident engineer in charge of construction on the Buffalo, Rochester & Pittsburgh (now part of the Baltimore & Ohio). In 1884 Mr. Gilcreast was appointed division engineer on the latter road. From 1885 to 1889 he was employed as construc-

tion engineer for the contractors on the construction of the Croton Aqueduct, New York City water supply. In 1889 he reentered railroad service as division engineer in charge of construction and maintenance of the Schuylkill & Lehigh Valley (now Lehigh Valley), continuing in that capacity until 1893. From 1893 to 1911 he was employed as division engineer in charge of construction and maintenance of the Hazelton division of the Lehigh Valley. In January, 1911, Mr. Gilcreast entered the service of the Lehigh & New England as chief engineer in charge of construction of the Tamaqua extension. Upon the completion of that construction project in December, 1913, he was appointed engineer maintenance of way, with headquarters at Bethlehem.

**Alfred E. Perlman**, whose appointment as assistant engineer maintenance of way of the Chicago, Burlington & Quincy, with headquarters at Chicago, was reported in the June issue, was born on November 22, 1902, at St. Paul, Minn. He was educated at the Massachusetts Institute of Technology, graduating with the degree of Bachelor of Science in



Alfred E. Perlman

1923, and also took a course in railway transportation at the Howard School of Business Administration during the summer of 1930. He first entered railway service on June 8, 1918, with the Minneapolis, St. Paul & Sault Ste. Marie and served with various railroads during summer vacations from school. Following his graduation, Mr. Perlman entered the service of the Northern Pacific on July 7, 1923, as a construction draftsman. On July 11, 1924, he was made an extra-gang laborer and on March 1, 1925, he was appointed inspector of icing facilities at St. Paul, Minn. In April, 1926, Mr. Perlman was sent to Glendive, Mont., as assistant supervisor of bridges and buildings and in November of the following year he was appointed roadmaster, with headquarters at Carrington, N. D., being transferred to Sandpoint, Idaho, in April, 1929, and to Staples, Minn., in December, 1930. In October, 1934, he was assigned to special duties in the office of the vice-president in charge of operations and in the following month he was loaned to the Railroad division of the Reconstruction Finance Corporation where he made studies of maintenance

conditions on lines making applications for loans. His recent appointment became effective on June 1.

**Arthur Daniels**, division engineer of the Twin City Terminals and the Iowa & Southern Minnesota divisions of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Minneapolis, Minn., has been appointed to the newly-created position of assistant superintendent track maintenance, with headquarters at Chicago. **D. C. Rhynsbarger**, assistant engineer with headquarters at Butte, Mont., has been promoted to division engineer of the Montana division, with the same headquarters, succeeding **W. F. McDonald**, who has been transferred to the LaCrosse-River division, with headquarters at LaCrosse, Wis., where he succeeds **W. H. Vosburg**. **E. W. Blomgren**, assistant engineer, with headquarters at Minneapolis, Minn., has been promoted to division engineer of the Twin City Terminals and the Iowa & Southern Minnesota divisions, to succeed Mr. Daniels. **R. A. Whiteford**, assistant engineer, with headquarters at Savanna, Ill., has been promoted to division engineer of the Kansas City division, with headquarters at Ottumwa, Iowa. **E. H. Johnson**, division engineer of the Dubuque-Illinois division and the Kansas City division, with headquarters at Savanna, will retain jurisdiction over the Dubuque-Illinois division of this company.

## Track

**C. A. Hatch**, foreman of a ballast gang on the Atlantic Coast Line has been appointed roadmaster, with headquarters at Leesburg, Fla., to succeed **D. E. Kirkland**, deceased.

**Ben Hager**, assistant roadmaster on the Chicago & North Western, with headquarters at Adams, Wis., has been promoted to roadmaster at Fond du Lac, Wis., to succeed **A. E. Benson**, who has been transferred to Sterling, Ill. Mr. Benson replaces **Patrick J. McAndrews**, deceased.

**Albert W. Stone**, assistant to roadmaster on the Cincinnati, New Orleans & Texas Pacific (part of the Southern System), who has been promoted to track supervisor on the Mobile division of the Southern, with headquarters at Selma, Ala., as announced in the July issue, was born on August 25, 1903, at Louisville, Ky. Mr. Stone received his higher education at the University of Kentucky and entered the service of the C.N.O. & T.P. in May, 1924, as a rodman. In the fall of that year he was appointed junior engineer and in 1934 he was promoted to assistant to roadmaster.

**M. B. McAdams**, roadmaster on the El Paso-Amarillo division of the Chicago, Rock Island & Pacific, with headquarters at Dalhart, Tex., returned to his duties on July 1 after a leave of absence of several months, displacing **H. M. Long**, who has been transferred to the Cedar Rapids-Dakota division, with headquarters at Iowa Falls, Iowa, where he succeeds **J. Colles**, whose death is noted elsewhere in these columns. **R. A. Brown**, a track

inspector on the Rock Island, has been appointed roadmaster, with headquarters at Peoria, Ill., succeeding **W. E. Haberslaw**, who has been granted a leave of absence. **Paul Buser**, formerly a roadmaster on this road, has been appointed acting roadmaster, with headquarters at Estherville, Iowa, to succeed **J. W. Peterson**, who is on a leave of absence.

**Cornelius C. Pelley**, a road foreman on the Illinois Central, with headquarters at Chicago, has been appointed acting road supervisor with the same headquarters, replacing **R. H. Carter**, whose appointment as acting division engineer is noted elsewhere in these columns.

**W. C. Sheehan**, assistant supervisor of track on the Lehigh Valley, with headquarters at South Plainfield, N. J., has been promoted to supervisor, with headquarters at Jersey City, N. J., succeeding **John Sheehan**, his father, whose death on June 18 is noted elsewhere in these columns. The position of assistant supervisor at South Plainfield has been abolished.

**R. S. Kniffen**, a trainmaster on the Great Northern, has been appointed general roadmaster, Lines East, with headquarters at Duluth, Minn., succeeding **Thomas C. Deighton**, whose death is



R. S. Kniffen

noted elsewhere in these columns. Mr. Kniffen was born on November 4, 1886, at Darien, Wis. He entered the service of the Great Northern in 1906, serving as laborer, timekeeper, track foreman and extra gang foreman until 1913, when he was promoted to district roadmaster. After serving in the latter position at various points Mr. Kniffen was promoted to division roadmaster of the Havre division, with headquarters at Havre, Mont., in 1919. In the following year he was transferred to the Mesabi division, with headquarters at Superior, Wis., and in 1928, he was advanced to general roadmaster, serving in this position at St. Paul and Duluth. In 1930, Mr. Kniffen was transferred to the operating department as trainmaster, which position he held until his recent appointment.

**George W. Dailey**, transitman on the Buffalo division of the New York Central, with headquarters at Rochester, N. Y., has been appointed assistant track supervisor at North Tonawanda, N. Y., on the

same division, to succeed **William G. Cowie**, who has been transferred to Batavia, N. Y., to succeed **F. B. Wilcox**. Mr. Wilcox has been promoted to assistant division engineer on the Pennsylvania division, with headquarters at Jersey Shore, Pa., to succeed **W. E. Carnes**, who has been promoted to supervisor of track, with headquarters at Clearfield, Pa. Mr. Carnes succeeds **Andrew Olson**, who was retired from active service on July 1. **C. A. Maxeimer**, supervisor of track on the St. Lawrence division, with headquarters at Carthage, N. Y., has been transferred to Tupper Lake, on the same division, to succeed **M. H. LaRouche**, who has been transferred to Oneida, N. Y., on the Mohawk division, to succeed **J. J. O'Neil**. Mr. O'Neil has been transferred as supervisor of track to Rochester, N. Y., on the Syracuse division, to succeed **G. J. Bowe**, who has been appointed supervisor of track at Syracuse, N. Y., on the Syracuse division, to succeed **W. N. Skelton**, who was retired from active service on July 31.

## Bridge and Building

**D. E. Lewis**, assistant general foreman in the bridge and building and water service department of the Atchison, Topeka & Santa Fe, with headquarters at Winslow, Ariz., has been appointed general foreman in the same department, with the same headquarters, to succeed **W. F. Martens**, who has been transferred to San Bernardino, Cal. Mr. Martens replaces **J. W. Wood**, who has retired.

**George H. Hout**, carpenter foreman on the Mohawk division of the New York Central, has been promoted to bridge and building inspector on the Mohawk division, with headquarters at Albany, N. Y., to take over the duties of **W. B. Burke**, assistant supervisor of bridges and buildings, who has been promoted to supervisor of bridges and buildings on the River division at Weehawken, N. J. Mr. Burke succeeds **J. K. Bonner** at Weehawken, who has been transferred to the Buffalo division, with headquarters at Buffalo, to take the place of **J. H. Vosburgh**, who has retired.

**C. A. Lichty**, a past-president of the American Railway Bridge and Building Association, who has served as secretary of this organization for the last 25 years, retired on July 1 as a material inspector in the purchasing department of the Chicago & North Western, with headquarters at Chicago. Mr. Lichty was born on May 24, 1865, at Waterloo, Iowa, and was educated in civil engineering at the University of Iowa, Iowa City, Iowa, from which he graduated in 1890. He first entered railway service that year with the Lake Erie & Western (now part of the New York, Chicago & St. Louis), serving as chief draftsman for this company until 1892. On July 1 of that year, Mr. Lichty entered the service of the Chicago & North Western as acting division engineer of the Madison division. In 1896, he was appointed engineer in charge of the construction of double track on the same division. Two years later he was

transferred to Iowa, where he had charge of the construction of various lines in that state. In 1900, Mr. Lichty was appointed superintendent of bridges and buildings of the Iowa division, being transferred to the Northern Wisconsin



C. A. Lichty

division two years later. In 1906, he was appointed material inspector in the purchasing department, with headquarters at Chicago, which position he continued to hold until his retirement.

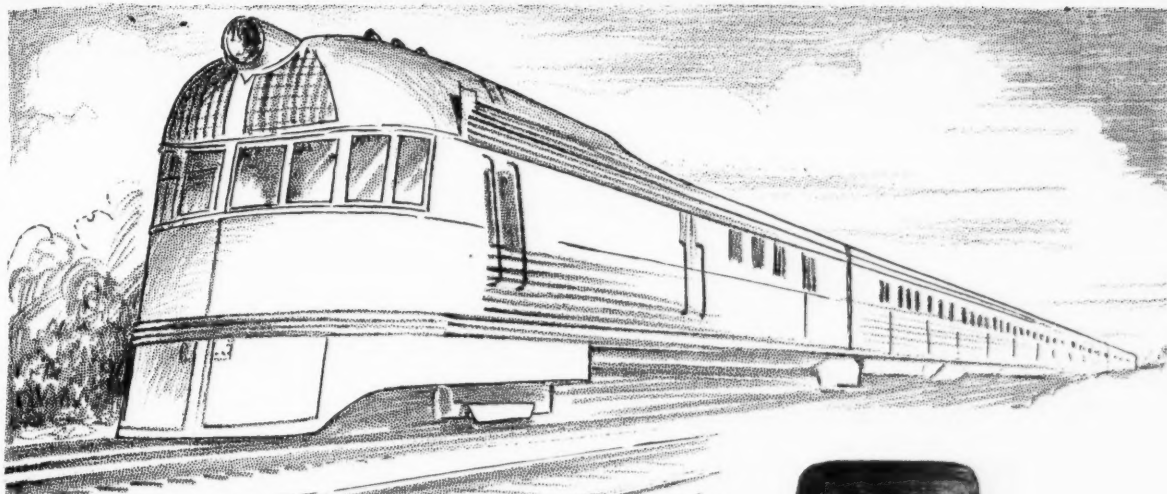
## Obituary

**Heston Driskell**, a track supervisor on the Evansville division of the Louisville & Nashville, with headquarters at Cloverport, Ky., died on May 15 at that point. Mr. Driskell was born on January 9, 1871, in Breckenridge county, Ky., and entered the service of the L. & N. on September 14, 1895, as a trackman. On November 1, 1897, he was advanced to track foreman, and on April 20, 1909, he was further promoted to track supervisor, which position he held until his death.

**J. Colles**, roadmaster on the Cedar Rapids-Dakota division of the Chicago, Rock Island & Pacific, with headquarters at Iowa Falls, Iowa, died in that city on June 14. Mr. Colles was born on July 12, 1874, in Prague, Bohemia, (now Czecho-Slovakia) and entered railway service in this country on July 1, 1892, as a trackman on the Rock Island. On August 1, 1898, he was made a track foreman and on December 16, 1916, he was further advanced to roadmaster. Three years later he was appointed an extra gang foreman and on January 29, 1920, he was re-appointed to the position of roadmaster.

**Thomas C. Deighton**, general roadmaster of the Great Northern, Lines East, with headquarters at Duluth, Minn., died on June 16. Mr. Deighton was born on November 6, 1874, at Massillon, Ohio, and first entered railway service in 1896, with the Great Northern. On May 5, 1900, he was made a track foreman and on April 18, 1910, he was further promoted to assistant roadmaster on the Cascade division. On October 10, 1915, Mr. Deighton was advanced to division roadmaster on

(Continued on page 474)



# ***SPEED*** with **SAFETY** and **COMFORT**

The new streamlined trains give the traveling public what it desires—high speed transportation that is safe and comfortable.

These splendid trains deserve all of the praise they have received, but it must not be forgotten that fast, smooth, strongly constructed track also has played a vital part in making possible the new speed records.

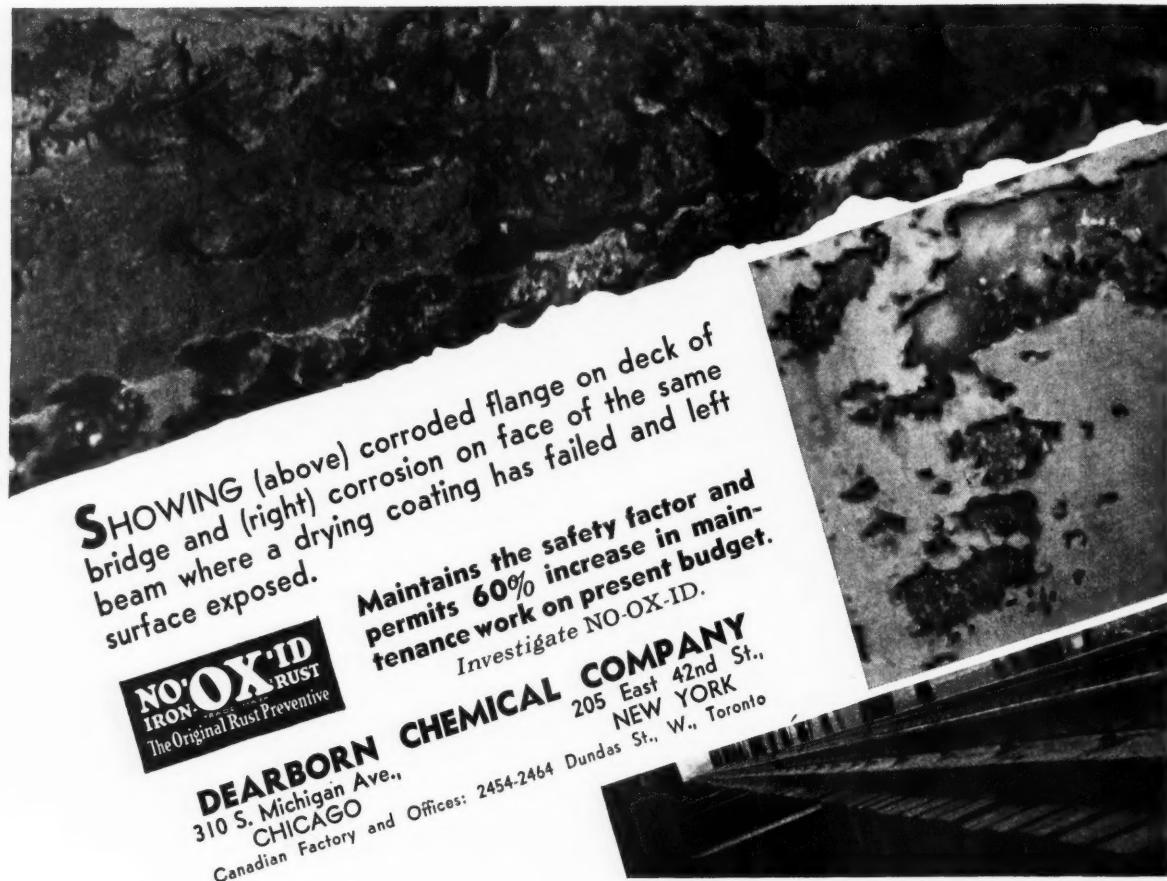
Perfect track is essential to the proper operation of high speed trains. The use of improved track devices, such as Woodings Rail Anchor, is more necessary than ever in this new era.



## **WOODINGS RAIL ANCHOR**

**Lowest Cost  
Highest Reapplication Value  
Maximum Efficiency  
Millions in Service**

**WOODINGS FORGE & TOOL CO.**  
Verona, Penna.



**SHOWING** (above) corroded flange on deck of bridge and (right) corrosion on face of the same beam where a drying coating has failed and left surface exposed.

**Maintains the safety factor and permits 60% increase in maintenance work on present budget.**  
Investigate NO-OX-ID.

**NO-OX-ID**  
IRON-RESISTANT  
The Original Rust Preventive

**DEARBORN CHEMICAL COMPANY**  
310 S. Michigan Ave.,  
CHICAGO  
Canadian Factory and Offices: 2454-2464 Dundas St., W., Toronto  
205 East 42nd St.,  
NEW YORK

## ALPHABETICAL INDEX TO ADVERTISERS

**A**  
Air Reduction Sales Co.....440  
American Bridge Company.....434-435  
American Sheet and Tin Plate Co.....434-435  
American Steel & Wire Company.....434-435  
Armco Culvert Mfrs. Assn.....433

**B**  
Barco Manufacturing Company.....439

**C**  
Carnegie Steel Company.....434-435  
Chipman Chemical Company, Inc.....479  
Columbia Steel Company.....434-435  
Cyclone Fence Company.....434-435

**D**  
Dearborn Chemical Company.....480  
Detroit Harvester Co.....476

**E**  
Eaton Manufacturing Co.....432

**I**  
Illinois Steel Company.....434-435  
Ingot Iron Railway Products Co.....433

**L**  
Lorain Steel Company, The.....434-435

**M**  
Maloney Oil & Manufacturing Co.....478  
Metal & Thermit Corporation.....481

**N**  
National Lock Washer Company, The.....431  
National Tube Company.....434-435  
Nordberg Mfg. Co.....436

**O**  
Oxweld Railroad Service Co., The.....437

**R**  
Railway Track-Work Co.....479  
Ramapo Ajax Corporation.....442

**S**  
Scully Steel Products Company.....434-435  
Simmons-Boardman Pub. Co.....476-477-478  
Sinclair Refining Company, Inc.....478

**T**  
Tennessee Coal, Iron & Railroad Co.....434-435  
Timken Roller Bearing Company, The.....482  
Track Supply Association, The.....475  
Truscon Steel Co.....476

**U**  
Union Carbide and Carbon Corp.....437  
United States Steel Corporation Subsidiaries.....434-435  
United States Steel Products Company.....434-435  
Universal Atlas Cement Company.....434-435

**W**  
Warren Tool Corp.....478  
Woodings Forge & Tool Co.....473



## 25% to 40% LONGER RAIL LIFE

**where Welding eliminates these Weak Spots**

And, longer rail life is but one of the many economies effected by welding rails into long, continuous lengths. With rail joints eliminated, frequent track lining and surfacing become unnecessary, joint maintenance is banished.

Long welded rails are not an untried experiment. For several years, in Germany and Australia, the welding of four or five standard length rails into one continuous rail has been the established practice. In America, welded rails in

long lengths have been giving satisfactory service for the past year and a half. No trouble from expansion or contraction has developed on any of this welded track.

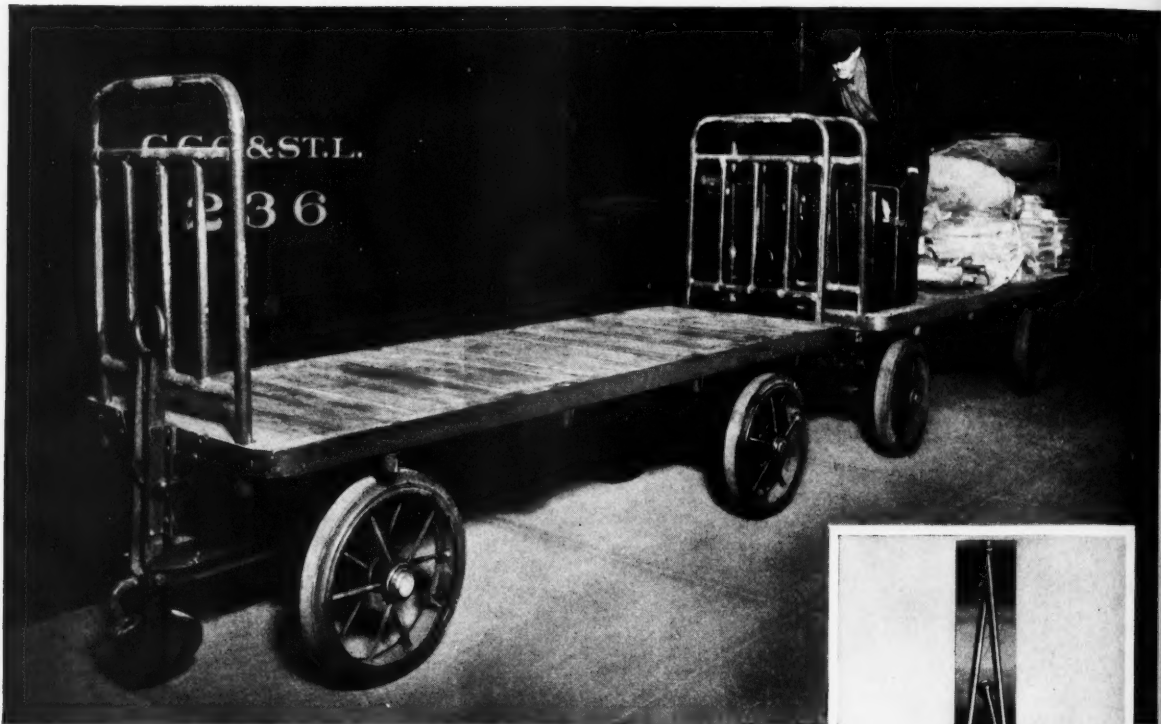
Thermit Pressure Rail Welding provides a weld as strong as the rail itself. This weld can be installed by your own track forces at a cost comparable with that of an ordinary rail joint. It will pay you to investigate. Let us send you the complete story of Thermit Rail Welding.

# **THERMIT *Rail* WELDING**

**METAL & THERMIT CORPORATION • 120 BROADWAY, NEW YORK**  
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

# TIMKEN-EQUIPPED Trucks

## Speed Up Baggage Handling



Modern baggage trucks equipped with French & Hecht Timken Bearing Equipped wheels.

**T**HE day of the old wobbly-wheeled, noisy, hard-to-haul baggage truck is over. Modern trucks roll smoothly, swiftly and silently on Timken Bearing Equipped wheels.

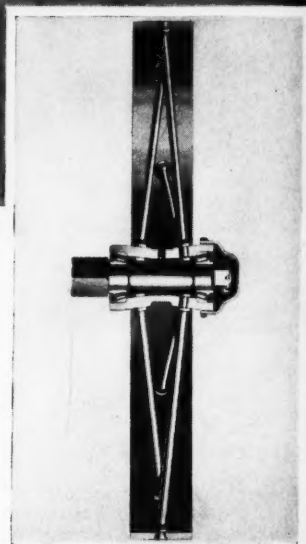
Baggage can be handled with greater dispatch on Timken-equipped trucks because more weight can be hauled per truck and more trucks per train where tractor haulage is employed.

And what is equally important, Timken-equipped trucks require very little attention for lubrication and maintenance.

Timken is the ideal baggage truck bearing because it combines full anti-friction efficiency with greater load capacity than any other type of bearing, size for size. It carries thrust loads as well as radial loads, and both together in any combination.

Should slight looseness develop after long service, Timken Bearings can be restored to their original accuracy of contact by means of a simple adjustment. When buying new baggage trucks specify Timken-equipped—then you will know they are modern.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO



Section of a French & Hecht wheel showing Timken Bearing application.



# TIMKEN TAPERED ROLLER BEARINGS

